July 4, 1945

# NATIONAL PETROLEUM NEWS

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DETROIT

## NPN CHECK SHEET
## BULK PLANTS AND WAREHOUSES

Location _____

Manager _____

Checked by _____ Date _____

**CHECK EVERY ITEM**

**Code**

*Satisfactory* . . . OK

*Needs Attention* . X

**YARD**

1 Condition of fence:
posts___gates___wire___paint___
2 Condition of floodlights___night
3 Condition of roadways___
4 General appearance:
weeds___tall grass___rub
5 Overnight parking space f
tank wagons___

**OFFICE**

6 Condition of windows: s
7 Safe: burglar-proof___
night light___
8 Heater: safe___right l
shielded___
9 Lockers: enough space
material___
10 Wash room: clean___w
toilet___clean lavatory
soap___

**WAREH**

16 Stored mer inkin use: enough
clean___
17 Condition of loading platform (
foundation___floor___proper he
bumpers___
18 Fire prevention: oily rag safety-can___
fire extinguishers serviced regularly (date last
serviced_____)
19 Condition of tanks: properly installed___level___
sound foundations___supports___manhole covers
tight___seams tight___rivets titht___
paint (date last painted_____ ) condition now___

**USE, CONTINUED**

d catwalks: anchored___safe___
___cages (on ladders above 20 feet)___
uge all tanks from catwalk___

ally grounded___

spected regularly___

e freely___free from leaks___

valve seats clean___

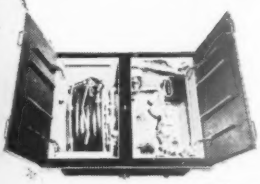
perly installed___
from leaks___
1 liquids): vapor tight___
ature reading devices:
glass clean___scales clean___
operating v ot explosi nt line
vided between motors and pumps___
rs and switches: clean___conveniently
e (explosion-proof or installed more than
e the floor)___
n of pumps: free from leaks___
ot run hot___suction-line strainers clean___
36 Condition of lights: vapor-proof___enough light___
37 Fire extinguishers: proper type___readily access-
ible___serviced regularly (date last charged _____
38 Are "No Smoking" signs prominently displayed___

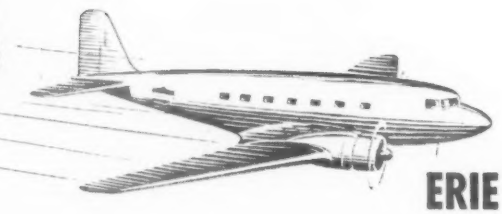
Are Your Plants and Facilities Ready for the Postwar Rush? NPN prints this week the first of a series of check sheets for the convenient listing of items that may need repair or replacement in order that oil marketers will be off to a flying start when the "breakthrough" comes and normal civilian business can be resumed. This week's article deals with bulk plants and warehouses. Other articles will cover tank trucks and truck transports and service stations. The check sheets (replica of which appears above) for bulk plants and warehouses are on *p. 23 and 24* in this week's issue with an explanatory material and helpful hints on the proper filling in of the forms starting on *p. 19*.

R v.37³ Jy-S194

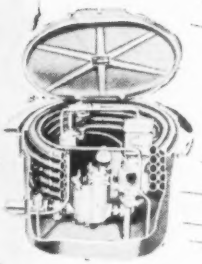
# What G.P.M. do you need?

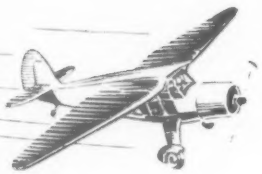
UP TO 100 G·P·M·



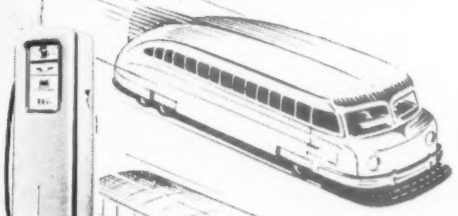


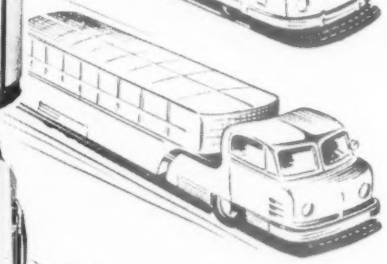
20-40 G·P·M·



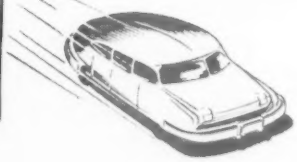


12-15 G·P·M·

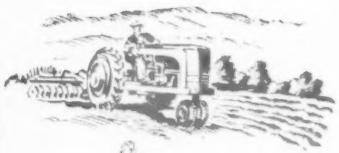




12-15 G·P·M·



8-10 G·P·M·



## ERIE FUELING SYSTEMS *are available up to 4000 G.P.M.*

**On the Farm**—Erie's complete line of hand operated barrel and pedestal pumps and tank units easily provide 8 to 10 G.P.M.—fast enough for any farm fueling demand.

**At the Service Station**—Erie's well-known computing pump provides 12 to 15 G.P.M.—fast enough for civilian cars. Here too, Erie hand pumps meet any kerosene, alcohol, or lube oil dispensing demand.

**At the Bus and Truck Terminal**—Erie's non-computing pump provides 12 to 15 G. P. M.—fast enough for medium sized buses and trucks. Erie JR Pit and Submerged Turbine Pump will provided greater G. P. M. if needed for larger vehicles.

**At the Airport**—Erie's JR Pit Dispenser provides up to 40 G. P. M.—the Senior Pit Dispenser up to 100 G. P. M. and complete fueling systems up to 4000 G. P. M. are available for large Government or commercial fields.

* * * *

**ERIE facilities are working to produce materials for the Army, Navy and U. S. Maritime Commission. However, under certain conditions stipulated by Government regulations we are permitted to manufacture and sell the products described above for defense industries and essential civilian use. Consult us about your requirements.**

TECHNOLOGY

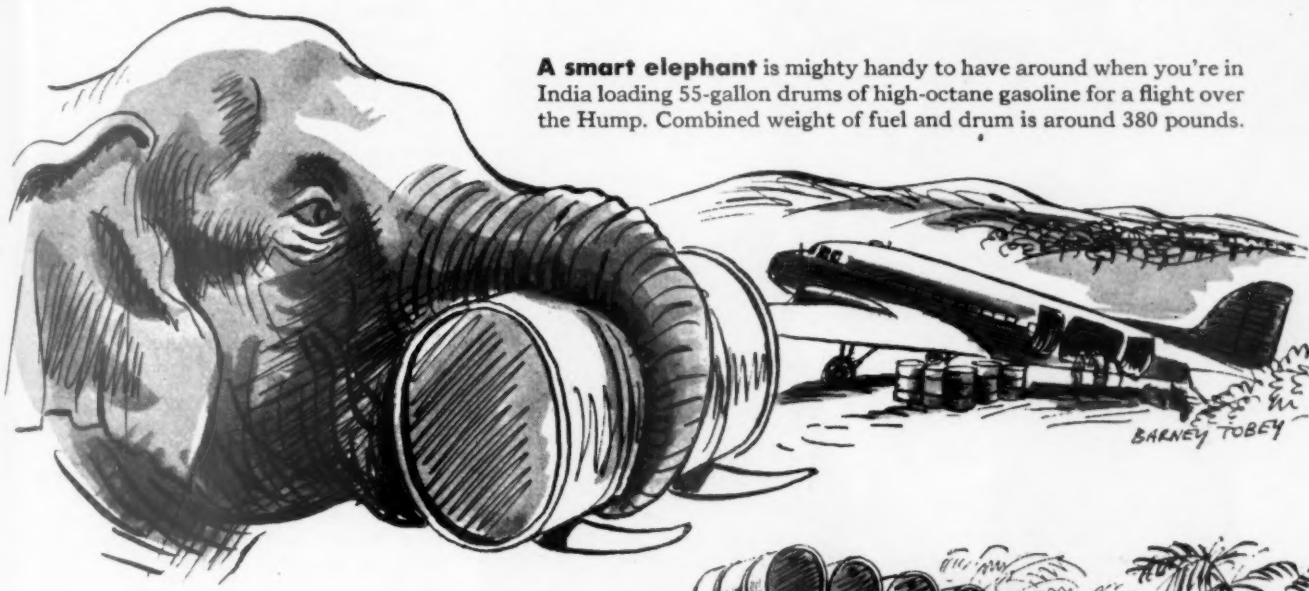
*Look to* **ERIE**

**ERIE METER SYSTEMS, INC.**

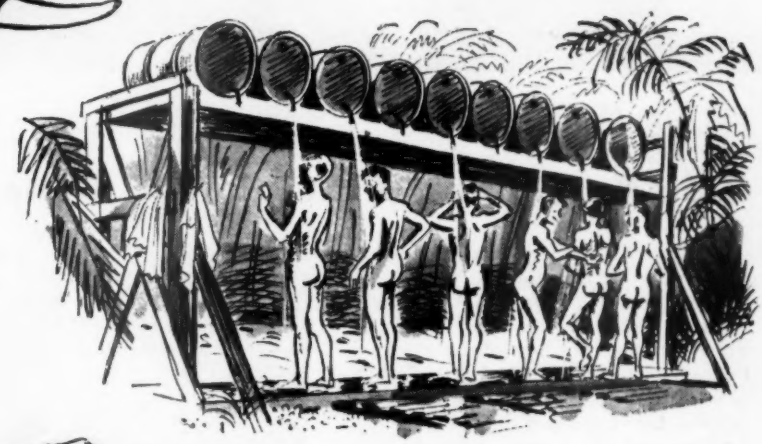
*Main Office and Plant: Erie, Pa.*

# The Best Gasoline is still fighting!

*Rough impressions of gasoline's role on the battle-fronts – based on actual incidents and official photos.*




**A smart elephant** is mighty handy to have around when you're in India loading 55-gallon drums of high-octane gasoline for a flight over the Hump. Combined weight of fuel and drum is around 380 pounds.



**Seabee ingenuity** turned nine empty gasoline drums into this luxurious shower somewhere in the Pacific. Other containers have wound up as ovens, stoves, sinks, washing machines, bathtubs, refrigerators and flower pots. With thousands of drums of high-octane gasoline going overseas every day, our men have plenty of "empties" to work with.

**"Muddy, buddy?"** But it can't stop a command car for long. The G.I. driver slips a cable around a palm tree, turns on a self-powered winch and lets the car pull itself free. Jungle driving is tough on gasoline supplies, but American and Allied fighters are getting all they need.

**ASK ANY MOTORIST** why the quantity of gasoline he can get these days must still be limited and he can give you a pretty straight answer. But many car-owners are hazy on why quality, too, has been rationed.

The fact is—the best gasoline that American refiners can produce, improved with Ethyl fluid, "is still fighting." Quantity restrictions have been eased a bit, but not until Japan goes the way of Germany can civilians expect the kind of gasoline that will bring out the full performance of modern high compression engines.

ETHYL
BRAND OF ANTIKNOCK COMPOUND
ETHYL CORPORATION
TRADE MARK REG. U.S. PAT. OFF.

**Ethyl**
**CORPORATION**
Chrysler Building
New York 17, N. Y.

*Ethyl is a trade mark name*

*Frank A. Epps*

## Quits Safety Post With Job Well Done

WHEN FRANK A. EPPS resigned last week as director of the facility security division for PAW Dist. 1, Deputy PAW Davies said that Mr. Epps' work in spreading safety operations throughout the district had been "all the more noteworthy, since it has been made despite the expanded operation of all facilities and the increased use of inexperienced labor by the oil industry."

This tribute to a quiet, hard-working executive, was only fitting recognition of the contribution Mr. Epps has made to the industry since he joined PAW in September, 1942.

Mr. Epps organized his staff in December of that year, and within the next twelve months his division had participated in 597 inspections of plant facilities. In addition to on-the-spot recommendations, its members formally asked for 2742 changes to improve safety or facility conditions.

In 1944, the group headed by Mr. Epps made 511 inspections with a total of 924 recommendations, and in the first five months of this year it made 116 inspections and 120 recommendations. Altogether, more than 80% of the recommendations to date have been put into effect. All suggestions were made with the knowledge that some difficulty would be encountered in carrying them out, due to the shortage of critical materials.

Mr. Epps, who was born in Richmond, Va., on Aug. 3, 1893, was graduated from the University of Pennsylvania in 1916 with a degree of B.S. in mechanical engineering. He joined Tide Water Associated Oil Co., Inc., and for 13 years was a safety engineer in that company. Later he transferred to the operating and production division, but he retained his interest in safety work.

From 1935 to 1940 Mr. Epps was associated with Gulf Oil Corp. He left to head his own distributing firm, Spartan Oil Co., of Dover, N. J., and was president of the latter company when he went into government service in 1942. He will resume his duties with his own company.

After an association of more than two decades with fire prevention and safety work in the oil industry, Mr. Epps is known as one of the foremost authorities in that field. He has been a member of the fire protection committee of the American Petroleum Institute for 24 years, and has been a director of the National Fire Protection Association and a member of its inflammable liquids committee for 20 years.

Mr. Epps will be succeeded in his PAW post by Frank S. Proctor, his former assistant, who has been named acting director.

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## BULLETINS

### NO PRODUCTION LOST AT TEXACO

**PORT ARTHUR, Tex.—PAW officials told NPN today that no production has been lost in The Texas Company refinery here which was seized July 1 by the government following a walkout of 250 Negro workers.**

**A. P. Frame, director of PAW's Refinery Division who came from Washington to seize the plant, said production was normal and the seizure was made before there was any loss.**

**Mr. Frame said that 22 Negro workmen whose walkout precipitated the strike of the other Negroes were back on the job, which they left because of alleged "racial discrimination as to pay". The Company and Union, Frame said, are obeying the WLB directive to negotiate over the cause of the disturbance.**

*(For earlier story see p. 3.)*

* * *

### ENTERS TIDELANDS FIGHT

**AUSTIN, Tex.—State Board of Education was on record today with resolution supporting fight of states against federal government taking over title to Tidewater oil lands.**

**Resolution stated if the federal claim is sustained the state school endowment will be endangered, and urged Texas Congressmen to work for passage of law which would "forever settle the matter by giving the title to the states."**

* * *

### FACILITATES PREMIUM PLAN

**WASHINGTON—OPA announced last week that all new well statements filed after July 1, for 23 counties of Texas, must be accompanied by a copy of the supplemental allowable report issued by the Texas Railroad Commission for each completed new well. The action is being taken to facilitate the administration of the stripper well premium plan.**

* * *

### VOTE TO BLOCK GAS LINE

**BATON ROUGE, La.—The state's Natural Gas Conservation Committee has voted to intervene in an application for a gas line from Kansas to Michigan, even though the line would carry no Louisiana natural gas. The expected application is that of the American Light and Traction Co. to construct a 27¾ inch line which would carry 300,000,000 cubic feet daily from the Hugoton field in Kansas to a point 65 miles from Detroit for storage in an abandoned gas field for use at winter peaks.**

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# War Department Outpaces States, in Urging Firm Oil Policy; Stresses 'Full Protection' for Americans in Foreign Field

NPN News Bureau

WASHINGTON — The American oil industry wants nothing more than to lay all of its cards on the table with the government in its post war foreign operations and in return, to obtain full and speedy support for its ventures abroad.

That appears to sum up many thousand more words of testimony offered the Senate Petroleum Investigating Committee this week by several prominent industry leaders intimately acquainted with problems of production, refining, marketing, exchange involved in foreign oil operations and their diplomatic history.

Mr. Charles B. Rayner, who led off two days of hearings before the Senate group on the subject of "diplomatic protection," expressed the State Department's urgent desire for a "strong foreign oil policy," speaking as that agency's petroleum advisor.

The agency of the federal government which really laid it on the line was the War Department, whose views were presented by Brig. Gen. H. L. Peckham. In a three-page short but to-the-point statement, he hammered out these points:

American nationals should be "fully protected" by our government in the development of their legitimate enterprises in the Middle East and other foreign fields. They should have the assurance that they can compete on equal terms with other nations in these fields and that their property and other legal rights will be fully supported by the U. S. government.

### Might Mean Military Power

Although Gen. Peckham has full faith in the new world peace organization just drawn up in San Francisco, he made abundantly clear that "full protection" could mean military power—which should be a matter for Congressional decision if and when necessary—although diplomatic means of settlement should be the first line of defense.

As a "corollary" to such protection, however, Gen. Peckham added: "All possible arrangements should be made to prevent American nationals from disposing of their foreign oil resources by sale or lease without the approval of the United States Government. Only in this way can the nation be assured of all possible utilization of foreign resources for defense needs in the future."

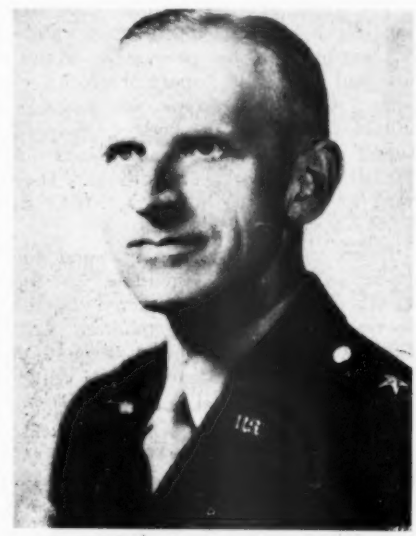
Sen. Joseph C. O'Mahoney (D., Wyo.) as chairman interrupted the general at this point in his statement to express slight wonderment at a recommendation which took on the faint aspect of an encroachment of the national power in a field which heretofore had been conspicuous for its spirit of "free enterprise".

The War Department spokesman did not argue very strenuously that the corollary suggestion was without tinge of governmental control, indicating that was the way the military feels about it—without any ifs, ands and buts. This was emphasized when, after the senate wondered if such a recommendation had the approval of the State Department, Gen. Peckham pointed out that Mr. Rayner had presented slightly vaguer language, but the War Department rejected it "because we felt it (the State Department language) did not go far enough."

### Four-Point Policy

A terse, four-point national petroleum policy was stated for the War Department by Gen. Peckham for the committee:

1. A pledge by the U. S. government to protect American nationals abroad.
2. Encouragement to American oil industry foreign operations with a view "to the maximum importation of petroleum to the U. S. consistent with the maintenance of a progressive and economically stable domestic petroleum industry."



Brig. Gen. H. L. Peckham

3. Early adoption and implementation on a multilateral basis—to include Russia among others—of the proposed Anglo-American Oil Agreement.
4. Acquistion of military reserves outside the continental limits of the U. S. "when such course is determined to be in the national interest."

Not only are foreign oil resources—in the hands of Americans—important as an additional reservoir in time of war, Gen. Peckham asserted, but they also are vital to the future peace of the world, adding:

"It must be realized that lack of oil has frequently been a cause of dispute

(*Continued on p. 6*)

NATIONAL PETROLEUM NEWS
NPN
NEWSMAGAZINE FOR OIL MANAGEMENT MEN

## Port Arthur Refinery Taken Over by PAW

NPN News Bureau

WASHINGTON—PAW this week took over the refinery of The Texas Co. at Port Arthur, Tex. The seizure was ordered by President Truman after employes walked out in a dispute involving suspension by the company of 22 cleaning and maintenance workers who had refused to perform cleaning work at established rates.

The workers are members of the Oil Workers International Union (CIO). The Eighth Regional War Labor Board had directed immediate termination of the strike, but the union refused to accept the board order.

According to a White House statement, the Port Arthur refinery is running about 135,000 b/d of crude and turning out about 56,000 b/d of military products, including 30,000 bbls. of 100-octane and 2,700 bbls. of 91-octane.

The statement quoted Undersecretary of War Patterson as stating "that there was a significant shortage of aviation fuels to meet operational requirements and that these requirements were rising." PAW was said to have reported at the same time that "the Petroleum Supply Program for which the Agency is responsible remains in an extremely critical condition" and to have stressed the need for operating all producing, refining and transportation facilities at full capacity.

The seizure was carried out by A. P. Frame, director of the PAW Refining Division, and H. F. King of PAW. Frame said F. L. Wallace, works manager of the Port Arthur plant, has been retained in that capacity.

Douglas P. Bailey, general superintendent of the plant said: "The government took over through a Presidential order to avoid complete shutdown. The Texas Co., while regretting the necessity for the government taking over, will cooperate in every way to continue full operation. The company was, and is ready to follow WLB in the dispute."

# Trade Names for Motor Oil Grades After War Are Recommended by A.P.I. Lube Committee

NPN News Bureau

CHICAGO—At the meeting of the A.P.I. Lubrication Committee here on June 19, the selection of a "general trade designation" for motor oils was made to designate conventional, intermediate and those types of oils meeting U. S. Army 2-104B and U. S. Navy 9000 series specifications.

Responding to a request from the motor car manufacturers for a group of designations which might be used in their service manuals for passenger cars, in order that motor oils might be provided which would meet interpretations of engine requirements, the committee considered a number of proposals.

The committee felt that no specifications or test limits should be assigned to the designations, which are to be adopted by the petroleum industry and the motor car manufacturers.

The following suggestions for nomenclature of motor oils have been submitted by various technical groups including the motor car manufacturers, the Society of Automotive Engineers lubricants division subcommittee and the Automotive Oil Section Technical Committee B of A. S. T. M.:

| Motor Oils | | |
|---|---|---|
| Conventional Grade | Intermediate Grade | Full Heavy Duty Grade |
| Normal Duty | General Service | All Purpose |
| Normal Duty | Severe Service | Heavy Duty |
| Regular | Premium | Heavy Duty |
| Normal | Heavy Duty | Heavy Duty Special |
| SAE No.— | SAE No.— Special | SAE No. Heavy Duty |
| SAE No.— | SAE No— (Passenger Car Heavy Duty) | SAE No.— TB-HD (Trucks Bus Heavy Duty) |
| SAE No.— | SAE No.— (Heavy Duty Type 1) | SAE No.— (Heavy Duty Type 11) |

In considering the proposals the committee felt that simplicity was of first importance and that whatever designations were finally selected they should be sufficiently descriptive to avoid, as far as possible, any misunderstandings on the part of the consumer.

### Draft Recommendations

It was resolved that the committee should present a recommendation to the Division of Marketing, A.P.I., that the nomenclature in the following paragraphs of the resolution be adopted by the A.P.I. and that motor car manufacturers be requested to include in their instruction books the recommendation that motor car operators use the premium grades of motor oil sold through service stations for passenger cars operated under conditions where regular oils do not give satisfactory service, and that on the termination of war such premium oils are expected to meet the following definition for Premium designation:

### Regular Oil

This term shall be used to designate a straight mineral oil. Oils of this type are generally suitable for use in internal combustion enigines under moderate operating conditions.

### Premium Oil

This term shall be used to designate any oil having proved oxidation stability and bearing corrosion preventive properties (detergency optional). Oils of this type are generally suitable for use in internal combustion engines where operating conditions are such that regular oils do not give satisfactory service. (High speed Diesel engines may require heavy duty oils.)

### Heavy Duty Oil

This term shall be used to designate any oil having proved oxidation stability, bearing corrosion preventive properties, and detergent dispersant characteristics. Oils of this type are generally suitable for use in both high-speed Diesel engines and gasoline engines under heavy duty service conditions. They must be of the U. S. Army 2-104B or U. S. Navy 9000 series type.

Before finally determining upon the grade designation of "Premium" for the intermediate grade as covered in the above resolution, the committee gave serious consideration to the designation "Extra Duty" for the intermediate grade.

Committees were selected by the chairman for the preparation of programs for promoting preventive maintenance for automobiles and trucks for the duration of the present emergency and the immediate postwar period; these committees to report at the next meeting of the committee.

Eastern representatives for the committee are B. G. Symon, H. S. Merriman and F. C. Kerns. Representing the Middle West are W. G. Clark, H. L. Moir, M. D. Gjerde, and for the Pacific Coast, B. W. Pickard, who will select the associates for his committee.

### More Speed After War

The lifting of rationing restrictions on gasoline, speed and tires is likely to result in owners driving at higher sustained speeds and taking longer trips, it was pointed out.

When the Pennsylvania Turnpike was opened, an alarming number of car and engine failures was reported, resulting from sustained driving speeds of over 70 mph. Most of these failures were attributable to such parts as fan belts, bearings, wrist pins, and so forth, even though many of the cars were in what would be considered good condition. Since that time the average car is possibly four or five years older, and when the motoring public starts driving again at prewar speeds similar failures may be at a much higher rate. In many cases, wartime driving has increased motor sludge and due to lack of manpower for servicing many engines are in such dirty condition that sustained high speed driving may bring trouble. Many automobiles may be operating marginally today: that is, impending trouble may be avoided only because of the curtailed speed at which the vehicle is being operated.

There is a possibility that branded motor oils may be unjustly blamed for failures which may occur due to these factors. For this reason the A.P.I. Lubrication Committee should perhaps sponsor some statement to the motoring public calling attention to the care that should be exercised in the operation of old and dirty engines at high speeds.

### Commends Medical Groups

The committee recognizes the importance of the new Medical Advisory Committee of A.P.I. and it was resolved that the committee would bring to the attention of this committee matters pertinent to its functions.

It was considered by the various members of the committee that this subject matter required further study, and it was resolved that this matter be included on the agenda of the next meeting.

The committee generally favors the use of the designation All-Purpose Gear Lubricant. It was felt, however, that this subject matter requires further discussion with technical advisors, and in view of this it was resolved that it be included on the agenda of the next meeting.

I. J. Fairchild, chief of the division of trade standards of the U. S. Bureau of Standards, advised the committee that the bureau was presently engaged in a study of filtration problems related to circulating systems attached to gasoline and Diesel engines, which has been


**NOTICE**

**SEND YOUR NEW OR RENEWAL SUBSCRIPTIONS DIRECT TO NPN**

NPN does not employ or authorize personal subscription solicitors.

Subscription soliciting rackets of one sort or another are going on all the time, but in times like these a rash of schemes is breaking out—including deals in which unscrupulous promotors take advantage of discharged veterans, especially those with physical handicaps.

Having no facilities to prevent identification forgeries or other schemes hatched up by promoters to victimize propective subscribers, NPN is adhering to its established practice of selling by mail only.

DO NOT SUBSCRIBE TO NPN THROUGH A SOLICITOR.

brought about by the need for additional agents such as anti-oxidation agents, oiliness agents, and so forth. Mr. Fairchild stated that there was no desire on the part of the bureau to set up any specification requirements for oils of this character. The purpose of bringing this matter to the attention of the Lubrication Committee was to draw the committee's attention to the fact that it has this problem before it and that the U. S. Bureau of Standards was ready and willing to be of service.

## Shannon Quits as FPC Counsel To Enter Private Practice

NPN News Bureau

WASHINGTON—Charles V. Shannon has resigned as general counsel of the Federal Power Commission and will enter private law practice here with Carl I. Wheat and Robert E. May, attorneys for the Independent Natural Gas Assn. of America, FPC announced this week.

Among the cases which Mr. Shannon argued as FPC general counsel since June, 1942, were the recent Panhandle Eastern and Canadian River-Colorado Interstate cases, in which the U. S. Supreme court on April 2, 1945, affirmed FPC orders requiring rate reductions of some $8,000,000 a year, and the Memphis Natural Gas Co. case, in which the Fifth Circuit Court of Appeals affirmed FPC's issuance of a certificate authorizing the company's construction of additional natural gas pipeline facilities.

Born in Illinois, in 1911, Mr. Shannon was graduated from Georgetown Law School in Washington in 1936. He joined FPC's legal staff in 1938.

## OPA Will Start Examinations Of Local Board Records

NPN News Bureau

WASHINGTON—On July 9 OPA district office representatives will start an examination of local board records in every city and town in the U. S., making a thorough check on gasoline ration issuance.

No review will be made of "A" coupon issuance—since every motorist is automatically entitled to such a ration—but a complete check will be made of all "C" ration issuance and a spot check of "B" and non-highway rations given consumers.

After the board's issuance is tabulated, it will be told specifically how many gallons, in the aggregate, it must trim in future grants to the applicants—if it is over the "quota." The object will be to bring issuance in line with the regulations as they stand and see to it that civilian gasoline consumption is brought into balance with PAW allocation.

## Arthur S. Hickok, Veteran Oil Distributor, Dies at Toledo

NPN News Bureau

CLEVELAND—Arthur S. Hickok, president of the Hickok Oil Co., Toledo, and board chairman and vice president of the Pocahontas Oil Corp. of Cleveland, died in a Toledo hospital on July 1.

In 1915 Mr. Hickok started the Hickok Producing Co., marketing stove oil. From this small business, the company grew along with the automotive industry until in 1928 it had become the operator of 280 filling stations in Ohio and Michigan.

In that year Mr. Hickok became affiliated with the Pure Oil Co. and took over operating control of several other companies, and a chain of 1800 stations in the Ohio-Michigan area, including the "Tower Stations."

Active in civic welfare in several Ohio communitiecs, Mr. Hickok supported the Hickok Recreation Field at Madison (O), and the Hickok Memorial Hospital at Geneva (O.).

Surviving him are his wife, his daughter and a son.

## Rogers Named I.I.P.A. President

*Special to NPN*

INDIANAPOLIS—R. G. Rogers, of the Guarantee Coal & Oil Co. here, has been named successor to the late Phil T. Williams as president of the Indiana Independent Petroleum Assn. He was elected to this office at a special meeting of the board of directors held over last week-end. James A. Hogshire of the Wake-Up System was made a member of the board of directors.

Both appointments are for the unexpired term of Mr. Williams.

## N.C.I.P.A. To Meet July 10-11

*Special to NPN*

INDIANAPOLIS — Invitations have been extended to all members of the National Council of Independent Petroleum Assns. by B. L. Majewski, chairman of the Dist. 2 Marketing Committee, to participate in the deliberations of the Dist. 2 Distributing and Marketing Committee in Chicago July 12.

The regular meeting of the council will be held July 10-11 at 10:00 A. M. at Hotel Sherman.

## In Spotlight as Indiana Standard Regroups Researchers

B. K. Brown | J. K. Roberts | M. T. Carpenter | R. N. Giles | R. C. Gunness

**Announcement has been made by Bruce K. Brown, vice-president of Indiana Standard, of the regrouping of Standard's research and development staff. Changes include promotion of Joseph K. Roberts to the position of general manager of research. Mr. Brown was assistant deputy petroleum co-ordinator from 1942 to 1944. Others in the new grouping are: D. P. Barnard will undertake liaison work with the sales department to see that programs in research will meet consumer demands and needs. At present Mr. Barnard is in Europe working on an investigation sponsored by the Army Air Forces; J. H. Forrester is now general supervisor of technical service and product inspection activities at all refineries; M. T. Carpenter has become director of Whiting laboratories; R. C. Gunness has been promoted from assistant director to associate director; R. N. Giles, former assistant director is now superintendent of the technical service division; A. B. Brown has been promoted to assistant superintendent in charge of technical service; C. R. Harte has been made assistant superintendent in charge of work on light oils technical service and will also continue to supervise economic studies**

# WAR DEPT OUTPACES STATES ON OIL POLICY

(*Continued from p. 3*)

between nations. An abundance of petroleum, available at moderate prices everywhere in the world, would tend to promote peace. It would also provide a source of cheap and convenient power that would be of inestimable assistance to nations that are faced with tasks of rehabilitation and development.

"The extent to which foreign oil should be imported into the U. S. in peace time should be determined in part by its effect upon the domestic industry. As we have previously stated, we should avoid importation which would unduly depress the domestic market price and thereby deplete the resources of domestic companies and adversely affect the incentive of the domestic oil industry in exploration and technological development."

As to acquisition of foreign military reserves, Gen. Peckham said that considerations of national security might make it desirable in the future. Such reserves, he said, "should be developed and operated by U. S. nationals using equipment and practices that are standard in our petroleum industry." He did not elaborate on the extent of government supervision that the War Department might think necessary in such operations.

Mr. Rayner's statement was, on the whole, merely a restatement of previous State Department expressions on the problem of foreign oil. He did say that the "strong foreign oil policy" the department desired did not rest solely in the Anglo-American agreement, for that is intended to be "only one part" of such a project.

However, the State Department adviser tangled with Sen. O'Mahoney on one point—that of oil imports to the U. S.—when he said: "Increased imports cannot be injurious to a domestic industry producing at its maximum efficient capacity."

Did Mr. Rayner mean that the most efficient unit in an industry was the one operating most cheaply, asked Sen. O'Mahoney, and did the State Department prefer importations of cheap foreign crude to stimulating domestic secondary recovery? To this, Mr. Rayner quickly replied no—that he did not mean the word "efficient" to mean "cheap."

Mr. Rayner made these points:

1. Failure of the Germans to capture Russian and Middle-Eastern oil resources was a principal factor in their defeat—and will be also for the Japs.

2. Oil has become very important during the war and demand for it will be "on a scale far in excess of prewar years."

3. If the U. S. fails to find substantial new reserves, it faces the "definite probability" of becoming a net importer of oil.

(On this point, B. Brewster Jennings of Socony-Vacuum, chairman of the industry group which presented testimony on foreign oil operations the next day, told Sen. O'Mahoney, in reply to a question, that he did not believe the prewar export-import relationship in the U. S. would change much "for several years (after the war), perhaps as long as a decade.)"

4. It is therefore "extremely important," Mr. Rayner concluded, to examine the activities of American nationals in foreign oil.

5. All of the above factors point "to the need for a strong foreign oil policy that fully recognizes our national interest in each of the oil areas of the world and promotes a program of action that is commensurate with our national responsibilities and our future security.

"Furthermore," he added, "it is equally important in the national interest that such a policy should be effectuated through international agreement on basic principles. The importance of such international agreement is accentuated by the problems that must be faced in the transition period from a war economy to the re-establishment of normal peace time activities."

Mr. Rayner said that the recognition of the American interest in foreign oil was the basis of the proposed Anglo-American oil agreement and that the effectiveness of the activities of the commission it would establish will depend upon "their merits, for neither the commission nor the government is given regulatory powers, but will look to the industry for voluntary compliance."

Committee Counsel Fraser suggested that there might be times when an American company would hesitate to follow

**WAR OIL NEWS from WASHINGTON**

HERBERT YOCOM *Bureau Chief*
NATIONAL PRESS BLDG.
NATIONAL 3477

**Industry members listen attentively as Charles Rayner, petroleum advisor in the State Department, tells Senator O'Mahoney's Petroleum Resources Investigating Committee of the growing importance of oil in international political relations. Left to right, Edward F. Johnson, general counsel for New Jersey Standard; J. E. Crane, New Jersey Standard; W. L. Faust (leaning on elbow), Socony-Vacuum; C. W. Hamilton, Gulf; B. Brewster Jennings, Socony-Vacuum; Oscar J. Dorwin, Texaco; George S. Ray, Texaco; and A. Jacobsen, Amerada**

the commission's recommendations if it were not granted anti-trust immunity, and Mr. Rayner agreed that might be so.

The industry's attitude of "let us put our cards on the table and then expect governmental support" was made clear by Edward F. Johnson, general counsel for New Jersey Standard, who presented a four-way recommendation, necessarily general in language:

### Expresses Industry View

Congress, he said, should be the instrumentality to develop a national oil policy; this policy should be lined with a governmental proclamation of backing for the American oil industry operating abroad; all foreign oil matters should be centralized in the State Department as soon after the war as may be appropriate, and treaties between the U. S. and other oil countries should be negotiated, definitely establishing mutual rights and obligations.

At the same time, Mr. Johnson revealed to Sen. O'Mahoney's committee some of the difficulties American oil companies are now experiencing abroad as a result of the war in Europe, adding: "In justice they must be worked out and (we believe) there is sufficient ingenuity in our government to find the proper formula for their solution."

He revealed that:

Romania is now taking oil produced by the wholly-owned Romania subsidiary of an American company, delivering the oil to Russia in payment for reparations, and making payments for the oil to the company in the rapidly depreciating local currency.

### Urges Payment In Dollars

The American oil man even now is unable to obtain permission for his representatives to enter countries occupied by Russia, such as Romania, Hungary, Poland and "perhaps others."

Great Britain has protected its nationals against confiscation of affected properties but so far there has not been any indication as to what will happen to properties owned by American companies in Finland, Germany, Romania and other enemy nations which may be or already have been ceded by such nations to others.

Mr. Johnson suggested that where territory is ceded, the acquiring nation taking over any American properties in the ceded area should be required to pay for them in American dollars. If such properties are not taken over, or they cannot be paid for in dollars, Mr. Johnson said they should continue in American ownership with all the usual commercial and legal rights and privileges incident to such ownership.

"Other property owned directly or indirectly by American oil interests in Europe," he added, "has been taken over by one United Nation or another. Unless some program is worked out to prevent such action or to make proper adjustments in such cases, our Allies will obtain sound value on their general claims against the defeated enemy at the expense of Americans and the affected American nationals will be relegated to the status of general creditors of the bankrupt enemy.

"Of course, if any property owned by the American oil industry be needed for war purposes, no complaint against the taking would be made, but in such cases payment therefore should be made in American dollars."

Mr. Johnson outlined the problems faced by American companies dealing abroad, describing briefly how they had been ousted from Bolivia through confiscation and from Mexico through expropriation and their activities substantially curtailed by government action in Argentina, Chile and Uruguay. He said

**State Department Petroleum Advisor Charles Rayner tells the Senate Oil Committee that petroleum is not only a prime source of national security and economy but a means of insuring peace among the world's nations and that the State Department proposes a "strong foreign oil policy," only one part of which is the proposed Anglo-American Oil Agreement**

that Americans were not permitted to participate in the search for oil in Brazil, adding that in Venezuela, "serious problems having been satisfactorily solved, the climate is now favorable."

### Doors Closed in Asia

Mr. Johnson pointed out that the door is closed to American companies in India and Burma and that in China and the Philippines, those countries' nationals are so favored that Americans are not likely to participate in oil development.

The first industry witness, who followed Gen. Peckham on the stand, was C. W. Hamilton of Gulf, who told the story of foreign oil exploration, production and pipelines, covering a century of time and relating to approximately 40 countries of the world where crude has been found in commercial quantities.

He asserted that two great World Wars within our generation had been won by the countries owning or controlling the largest and most available crude supply, adding:

"It would seem, therefore, that the United States should be able to best defend her national integrity and insure the freedom of her citizens in future years by maintaining substantial proved crude oil reserves within this country and by having access to the vast crude reserves developed, owned, or shared in by the American oil interests in friendly foreign countries."

He estimated for the committee that 39.6% or 17,200,000,000 bbls. of present estimated foreign crude reserves are held by American interests and added that American oil companies are now known to be directly or indirectly engaged in oil exploration in at least 11 foreign countries or areas of the world where commercial production or proved reserves have not yet been developed.

"That Americans have secured prospective oil lands in so many countries of the world and have developed such a substantial proportion of the estimated crude reserves outside of the continental United States is due, in my opinion," he said, "to two primary factors, the American competitive incentive in commerce and the belief that such foreign ventures are in the best interest of our government, both in time of peace and war."

### Industry Men Testify

Other industry witnesses were W. L. Faust of Socony-Vacuum, who discussed foreign oil marketing and refining, and J. E. Crane of Jersey Standard, who discussed the relationship of foreign exchange to American oil operations abroad.

Mr. Faust described for the committee how small refineries, built to comply with nationalistic policies in foreign countries, are uneconomical and result in high finished product cost to the consumer. He enumerated the following reasons which foreign governments advanced to justify local refiners: to promote national defense, save foreign exchange, secure foreign evchange, tax refinery profits, educate nationals in refining technique and supply refinery needs out of national production.

Mr. Faust traced the history of oil marketing abroad by Americans firms asserting that the availability of products throughout the world can be attributed to the foresight, thorough ground work in sound marketing principles laid down by American oil leaders, and to the large scale investments made to improve distribution and thus reduce the ultimate cost of the product. One of the major postwar problems of the American industry, he added, will be to reconstruct a strong marketing position throughout the world.

On the problem of foreign exchange,

Mr. Crane paid particular attention to the so-called "sterling area" which encompasses a large volume of trade and produces and consumes much oil.

He said that if, in the immediate postwar years, severe exchange restrictions were in effect in this area, especially against dollar transactions, and if movements of oil were not permitted on a free commercial basis, "American oil interests may be at a disadvantage compared with foreign trading companies whose home currency is sterling."

This development, he added, would force the American companies to accumulate blocked currencies usable only in a particular foreign area—which might prove "embarrassing," at a future date—or to sacrifice their business in the sterling countries.

## PAW Eases Pressure For 100-Octane

NPN News Bureau

WASHINGTON—With the approval of the military, PAW this week rescinded its orders to U. S. refiners requiring maximum yields of 100-octane and components by authorizing production cutbacks up to a fixed percentage of present output.

In terms of barrels per day of 100-octane, the cut will be relatively insignificant. On the other hand, it will enable some increase in production of other military products, such as fuel and Diesel oils, output of which has been held back by the necessity of maximizing 100-octane yields.

As for possible increased yields of civilian grade motor fuels, PAW already had taken this into account at the time it increased civilian allowances 140,000 B/D

While giving refiners relief from maximizing yields of 100-octane so long as the cutback each makes does not exceed a fixed percentage, PAW at the same time noted that it would continue to require maximum crude runs and also would maintain present rigid controls over the use of components and certain specifications of base stock (Directives 77 and 75). Instructons to refiners also make provision for a possible greater cutback by individual refiners but require prior PAW approval.

As an example of the kind of severe reforming operations it will now be possible to end, PAW cited a situation under which, in order to get one additional barrel of octane, it had been necessary to destroy about six barrels of naphtha.

## War Far From Over, Davies Warns

PETROLEUM ADMINISTRATION FOR WAR

WASHINGTON 25, D. C.

DEPUTY ADMINISTRATOR

June 26, 1945.

My dear Mr. Platt:

I want to thank you for the pleasant compliment of your editorial page in the June 20 issue. It was decidedly kind of you to so remember me upon the occasion of the "fourth anniversary."

The accomplishments of the Petroleum Administration in this war period have resulted from the support that it has had from the petroleum industry and from all related to the petroleum industry. Obviously, the Government's part of the job could never have been done successfully otherwise.

Yes, I can share with enthusiasm your hope that the fourth "birthday" may be the last. We shall all be happy to see this nightmare of war so dispelled and to get back to something normal. I know that my associates in PAW feel as I do and, in this spirit, when the war is at an end, will work as earnestly to wind up the affairs of this Agency as they did to bring it into being.

But the last year may be the hardest. As the war draws toward the end, there is almost universally a natural tendency to let up. And I note some of the patriotic fervor that went with the war in its earlier stages, when the outcome was in doubt, is missing now that full victory is a foregone conclusion and only the date is undetermined.

This won't do as to oil because, as you know, the military requirement for petroleum has not diminished with the end of the European war, but increased. We shall have all that we can do to make both ends meet over the period ahead. Production, refining, and transportation facilities must run on an all-out basis and only this, combined with a skillfully programmed and coordinated operation as a whole, will enable us to finish successfully.

So far in the war, as regards petroleum, the military order has been met in full, the wheels of industry have been kept turning without interruption, and the essential civilian requirement has been met. This, I think, does spell success -- to date. But the success will not be complete unless we can say as much when the last gun is fired. And to this I would add, until we have, as pledged, terminated the activities of the Agency created to administer the affairs of petroleum during the war.

Again, I thank you for your always sympathetic and helpful attitude and convey my highest regards and best wishes to you personally.

Sincerely yours,

Ralph K. Davies,
Deputy Petroleum Administrator.

FOR VICTORY BUY UNITED STATES WAR BONDS AND STAMPS

Mr. Warren C. Platt, Editor,
NATIONAL PETROLEUM NEWS,
1213 W. Third Street,
Cleveland 13, Ohio.

**Above is a reproduction of a letter from Deputy PAW Davies to NPN Editor Warren C. Platt expressing thanks for the report on his "4th birthday" in PAW. Mr. Davies warns that the war is far from over and that while petroleum requirements have actually increased there has been a noticeable letdown in productive endeavor**

## Oil Subsidies Authorization Bill Is Signed Into Law

NPN News Bureau

WASHINGTON—The signing into law of Senate Bill 502, which authorizes continuation of the stripper well, excess transportation and other subsidy programs, was announced by the White House last week.

Payments authorized under the various oil subsidy programs for the fiscal year starting July 1 total $290,000,000.

While signing the bill, President Truman said in a statement that he regarded it as the desire of Congress "that these subsidies shall be paid only as long as, and to the extent necessary to secure needed war production under existing price ceilings. As opportunity permits, therefore, subsidy programs will be reduced or discontinued as rapidly as feasible within the limits of the present law. Due consideration will be given, of course, to the legitimate needs of the producers and to the desirability of maintaining balance in our national and international procurement programs.

## Approves Tax Adjustment Bill

NPN News Bureau

WASHINGTON—The House Ways and Means Committee last week approved a tax adjustment bill (H.R. 3487) which would raise corporations excess profits tax exemption from $10,000 to $25,000, beginning with the 1946 tax year.

The measure carries out recommendations of Congress' Joint Committee on Internal Revenue Taxation.

## House O.K.'s Elk Hills Quota

NPN News Bureau

WASHINGTON — Legislation to allow production of crude from the Elk Hills Naval Reserve in California at an average rate of 65,000 b/d from now through 1946 won House approval last week and is now before the Senate.

## New Purchasing Agency Expedites Procurement

NPN News Bureau

WASHINGTON — The War and Navy Departments formally announced the establishment of a new joint Army-Navy Petroleum Purchase Agency on June 28 but made clear that—for the present at least—the move is being made only for the purpose of promoting "maximum coordination" between the two service arms "in accomplishing their procurement objectives."

While contracts will continue to be placed under direction of the respective commands, creation of the new unit may be a first step, however, towards eventual consolidation in a single agency of all oil-buying activities for the Army, Navy and the Army Air Force.

In the meantime, an immediate benefit so far as industry is concerned will be to provide oil men with a central point of contact with various purchasing branches. New Agency is headquartered under one roof—in Building J, Wing 1100, Washington 25, D. C.

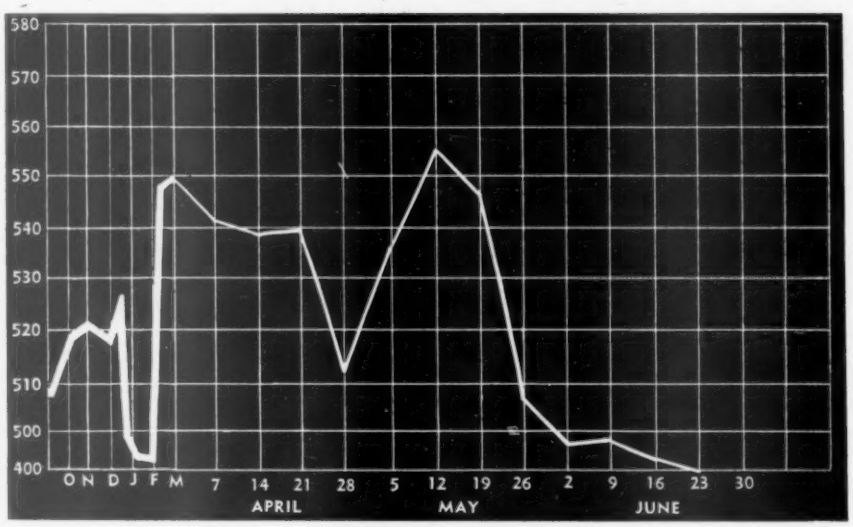
Purchasing units located in the agency are under the direction of Commander A. A. MacKrille, for the Navy Bureau of Supplies and Accounts, Lt. Col. Royal Linden, for the Fuels and Lubricants Division, Quartermaster Corps, and Col. Harry W. Howze for the AAF. All are former industry men: MacKrille from Shell; Linden from Union of Calif., and Howze from Jersey Standard.

### 18 to 29 Deferments Pared

NPN News Bureau

WASHINGTON—Orders have gone out from Selective Service headquarters to government agencies responsible for war production and war supporting activities, including PAW, to reduce the number of outstanding certifications of requests for deferments of registrants 18 through 29.

## Rail Hauls to East Lowest in Three Years




NPN News Bureau

WASHINGTON—Tank car movements to the East Coast during the week ended June 23 were lower than for any week in more than three years, PAW reported, with total hauls averaging only 395,785 b/d. Number of cars loaded by each company follows:

| | | | | | |
|---|---|---|---|---|---|
| Allied Oil Co., Inc. | 56 | Drake | 15 | Pure | 193 |
| Allied Oil Corp. | 7 | Elk Refining | 21 | Richfield | 95 |
| American Liberty | 22 | Franklin | 2 | Rock Island | 4 |
| Amsco | 153 | Geier-Jackson | 19 | Roosevelt Oil | 14 |
| Anderson-Prichard | 4 | Frontier Oil | 5 | Root | 92 |
| Arkansas Fuel | 6 | Gulf | 1247 | Royal Petroleum | 150 |
| Ashland Refining | 245 | Hartol | 86 | Shell | 579 |
| Asiatic Petroleum | 35 | Home Oil | 7 | Sinclair | 252 |
| Atlantic Refining | 522 | Industrial Oil & Gas | 7 | Skelly | 1 |
| James B. Berry Sons | 11 | Jenney Mfg. Co. | 134 | Socony-Vacuum | 1585 |
| Cantelou | 28 | Leonard | 5 | Southland | 24 |
| Carbide & Carbon | 47 | Libby | 3 | Southport | 11 |
| Chalmette | 28 | M. F. A. Refining | 7 | S. O. Indiana | 549 |
| Champlin | 8 | National Refining | 1 | S. O. Kentucky | 69 |
| Cities Service Oil Co. (Pa.) | 259 | Ohio Oil | 7 | S. O. New Jersey | 2108 |
| Cities Service Refining Corp. | 263 | Old Dutch | 16 | S. O. Ohio | 269 |
| Continental | 27 | Pan American | 743 | Sun | 1639 |
| Cosden | 63 | Pana | 4 | Talco | 34 |
| Crown | 3 | Petroleum Heat & Power | 4 | Texaco | 723 |
| Daugherty | 17 | Phillips | 187 | Tide Water | 93 |
| Delta | 8 | Pioneer | 1 | Tiona | 3 |
| Dornoil | 3 | Premier | 2 | Triangle | 11 |
| | | Primrose | 15 | United | 9 |

## Favorable Report Given Tidewaters Resolution

NPN News Bureau

WASHINGTON — House Judiciary Committee last week favorably reported Chairman Sumners' resolution giving up U. S. claims to "all lands beneath tidewaters and all lands beneath navigable waters within the boundaries of each of the respective states."

Remaining under federal control, if resolution is passed by Congress and signed by the President, however, would be (1) such lands beneath tidewaters and navigable waters as have been acquired by the U. S. government from the states, by clear and complete title, or by condemnation, and (2) lands held by the U. S. in trust for Indian tribes. In addition, federal government would keep present powers of regulating tidewaters for "purposes of commerce, navigation and the natural defense."

Meantime, it was learned that Attorney General Biddle does not plan to withdraw the suit filed in Los Angeles District Court against the Pacific Western Oil Corp., and file a new suit directly with U. S. Supreme Court. In recent letter to California's Attorney General, Robert Kenny, Interior Secretary Ickes said he would be willing that such action be taken.

D. J. spokesmen told N.P.N. that prior to the filing of the suit, Mr. Biddle told Mr. Ickes that he, the Attorney General, believed the action should be brought in the regular manner, proceeding through the Circuit Court of Appeals to the Supreme Court, if necessary, and they emphasized that Mr. Biddle is still of the same mind regardless of the Interior Secretary's suggestion to Mr. Kenny.

(Mr. Biddle ceased to be Attorney General on July 1, when he was succeeded by Tom C. Clark, of Texas, Assistant Attorney General—Ed. note)

### Proposes Transfer Plan For Prevention of Black Market

NPN News Bureau

WASHINGTON — A tentative plan controlling transfer of stations to prevent deliberate black market operations has been put on paper by OPA and is now circulating among various interested branches of the agency for final examination.

The plan, which is understood to have the approval of PAW and WPB, would put the burden of proof of trustworthiness of any person proposing to become the operator of a station. In addition, the operator, if found satisfactory by OPA, would be given a "working inventory"—not full inventory—for a probationary period of perhaps six to nine months, during which time his operations would be checked to determine his fitness.

The plan will call for a change in WPB's Directive 10 to OPA.

*Washington—By Herbert A. Yocom*

## Peckham Expresses War Department Views to O'Mahoney Committee

WASHINGTON—In two forthright statements to the O'Mahoney Committee within the past fortnight, Brig. Gen. H. L. Peckham personally has done more to lay the groundwork for a sound postwar petroleum policy than has any other single individual to date.

Mr. Yocom

The important thing, however, with respect to his exposition before the Senate Oil investigating group, is that the views he expressed were not just his own but those of the top policy makers in the War Department—a fact which the General himself made plain under questioning by Committee members. In other words, the General was stating top Army policy and doing it in a manner which leaves no doubt as to where this service branch stands on the subject of postwar oil supply.

The Peckham, or Army approach to the matter of future policy is both practical and realistic.

It reasonably suggests, on the one hand, the wisdom of protecting the domestic reserve position against the requirements of another war and advocates accordingly that demand on U. S. fields be relieved by the importation of foreign oil in reasonable amounts.

On the other, it recognizes that the best possible guarantee of an adequate supply of petroleum lies in the maintenance of a domestic industry that is both healthy and vigorous. In other words, while it may be prudent to supplement U. S. production by importing oil, those imports must not be in such quantities as would depress the domestic market price and lead eventually to the destruction of the American oil industry.

Also, it recommends giving strong encouragement to the development of American oil holdings abroad, with Government standing ever-ready to accord "full protection" to the legitimate enterprises of all U. S. nationals up to and even including the use of military force, if necessary. Furthermore, in order that the national interest might be fully protected at all times, it urges that advance approval of this Government be required before American nationals may dispose of their oil holdings in foreign lands.

Still another point in the Army program is that which suggests the possible future need for acquiring a military reserve of oil outside the U. S., while at the same time providing for their development and operation "by United States nationals using equipment and practices that are standard in our petroleum industry." To be noted, too, in this connection, is an attitude which opposes the idea that military holdings of crude in the ground in this country should be increased beyond the limits of the present Naval Petroleum Reserves.

What all this boils down to, in our opinion, is the welcome fact that at least one branch of the Federal Government is at last coming to down-to-earth grips with a situation which has been too long discussed in terms of hysteria and alarm by myriad bureaucratic harbingers of evil days, who would rather take over and run the oil industry as a government enterprise than to see it grow and prosper in the only way that could have enabled the U. S. to meet the unprecedented challenge of World War II. Accordingly, all oil men, whether independents or majors, ought not to find it difficult to go along with a policy which coincides generally with that outlined by Gen. Peckham, should it come about that this, indeed, is to be the National policy we adopt and pursue.

*Atlantic Coast—By Frank P. S. Glassey*

## Crampton Plan Out as U. S. - British Oil Pact for Europe Takes Shape

NEW YORK—If reports among foreign petroleum experts here are reasonably accurate, the United States and Britain will soon announce a series of agreements designed to assure the European civilian oil supply, at least for the next year.

Mr. Glassey

Unfortunately, the reports are still so vague as to be valueless, so far as any revelation of detailed terms of proposed pacts with European Governments are concerned. It is rumored, however, that the so-called "Crampton memorandum" has been scrapped as a basis of negotiation.

That plan has been referred to on many occasions in these columns, and its text was published in NPN of May 23. Either it could not stand the glare of publicity, or protests by some independent companies were strong enough to force its withdrawal. One executive of a major company explained to the writer that the memorandum had originally been intended only as an "aide memoire" while conducting discussions, and that it had never been drawn up with the thought that it would be adopted in entirety.

At any rate, the Crampton program seems to be dead, although it may merely be playing possum. But independents are more hopeful that they will get their share of the European civilian market when final agreements are announced by the State Department and by PAW in Washington.

Indication that such agreements are nearing final stages was seen in the formation last week of the bulk tonnage coordination committee, of which W. F. Dunning of Standard Vacuum Oil is chairman and H. A. Hassan of Sinclair Oil Corp. is vice-chairman. Once a certain number of tankers is allocated for civilian transport abroad, this committee will estimate regional requirements and will co-ordinate disposition of the tankers for various areas.

It's a common guess here that the European supply committee will be ready to function, so far as civilian needs are involved, by August. Meanwhile, in formulating oil-purchase agreements with European government, U. S. officials are working closely with the British.

It is rumored that some definite arrangements have already been made, although not officially announced in this country. One report is that Switzerland is to get oil products under a lend-lease provision; another is that France will receive 60,000 tons of crude oil, principally shipped from Haifa.

Prospective international pacts will presumably be concluded in consonance with the terms of Petroleum Directive 70, as amended, which provides that the foreign operations committee of PAW, or any of its subcommittees, may prepare and submit supply and import allocation schedules.

The director of PAW's foreign supply and distribution division is authorized to arrange with the War Shipping Administration for vessel tonnage to carry out approved schedules, while the foreign operations committee is authorized to coordinate its activities "with the British Overseas Supply Committee and the Ministry of War Transport, and with committees or agencies of the United States Government or of any of its allies or friendly nations."

° ° °

One of the latest pieces of advice to veterans who plan to operate gasoline filling stations has been issued by the Federation Employment Service, central Jewish employment and vocational guidance agency of this city.

The booklet is designed to inform veterans of opportunities in the metro-

politan area. Discussing service stations, it says:

"Few new locations are expected to be opened in the city after the war..... Greater opportunities in this business appear to be outside of the city."

"Successful operation depends on pushing up the sale of the other items in relation to gas. It is estimated that oil sales are in a ratio of 2% to gas sales.

"In the next period, stations are seen developing into minor auto repair shops, doing such repairs as wheel alignment, brake tightening, etc. Knowledge of how to perform such work can be obtained in two or three months by a person who is mechanically inclined."

* * *

Oil companies throughout the country will watch with unusual interest the operation of New York State's anti-discrimination law, which became effective on July 1. The statute bars discrimination in employment because of race, creed, color or national origin. Other states may adopt similar measures if New York's law proves effective and popular.

The law affects every employer of six or more persons. It creates a state commission against discrimination, which is to initiate its procedure upon all complaints, by resort to conference, conciliation and persuasion, under the auspices of a commissioner and his assistants.

The New York law provides stiff penalties for violation, and conceivably can generate plenty of headaches. The commission can subpoena any employer and require him to produce books, papers, records, correspondence and other documents.

The fear has been expressed that fraudulent and irresponsible complaints may be filed by disgruntled applicants or employes. On the employer rests the burden of proof that fair practices were followed in hiring, firing or promoting workers. Its implications are so widespread that they can only be guessed at until a few test cases are settled.

## PIPELINES — NPN Writers at Three Vital Points Discuss the Industry's problems

*Midwest—By Earl Lamm*

# Top Oil Men in PAW Grow Restive—Want Reconversion, Too

CHICAGO—Word continues to float in of the restlessness of a number of top industry men in the PAW organization in the various districts and in Washington, and is confirmed by the repeated appeals by Deputy PAW Davies that the oil companies permit their men on leave to remain with PAW in order to maintain an effective agency during the emergency. One of the latest such appeals was voiced in the last P. I. W. C. meeting, and if the most satisfactory results are to be obtained in the interest of the industry and oil for war, oil companies should satisfy the minds of PAW men concerning their future. General assurances like "You'll be taken care of," are not sufficient, for the men in PAW posts know that, in a stampede following a possible sudden ending of the war, or even in gradual conversion through a long war, there is a possibility that they will be left out, demoted or at best given their old jobs back. Like many returning veterans from the battle fronts, they deserve better than that, for their rich experience with PAW is pretty certain to have broadened their vision and given them an improved insight and understanding of industry methods, competition and human nature.

Mr. Lamm

These expressions are not without an appreciation for the predicament of the oil companies in the absence of some of their best men, who are badly needed on the organizations' home fronts during this semi-conversion period when concrete plans are being developed for the future. Most of the companies from whom the PAW men come are stressing research in the discovery of new oil reserves, better drilling and more effective production, refining and marketing methods over and above anything heretofore done. There is now more time for sizing up civilian trade and the much-proclaimed intensified competition to come than ever before and plans are down to earth. At least one big company in the Midwest is getting a new setup on an almost wholly research basis.

Everybody in all industries is weary of the professional planning that dominated last year and individual men and companies are filled with a strong urge to follow their own ideas. Collectivism in business is passing, and nobody but professionals will cry, but in all these individualized plans a spot should be picked for promotion of men temporarily away with PAW. There may be a momentary penalty for the company, but most of the PAW men will make it up when they return.

Nothing here should be interpreted as advocating a permanent PAW or anything of that sort, for we have protested it frequently, but it does seem sensible that the industry's good war record should not be spoiled, and that the men who contributed so largely to it should be justly rewarded.

Possibly more reductions in the PAW setup can be made, but top directors for each branch of the industry are certain to be needed for efficient operation. At the Dist. 2 PAW office is Chicago some gradual reductions in other directions have been made and effective July 1, marketing—the largest PAW department—moved from the 14th to the 12th floor at 624 S. Michigan, which reduced the occupied floor space by 2400 sq. ft., or about 20%.

* * *

A rumor along "Oil Row" (Michigan Boulevard) is that Walter Hochuli, PAW director of distribution and marketing, will leave PAW soon and return to The Texas Co. It is not known whether or not he will come back to his old job in Chicago as territorial manager or accept promotion elsewhere, but it is certain that his fondness for the Midwest will have a strong influence upon his decision, and his many friends in this area would extend a warm welcoming hand, for approval of his Washington activities has been unanimous. R. R. Kibbe, who took his place when he left for Washington many months ago, returned to his former position as territorial manager for The Texas Co. at Boston last week.

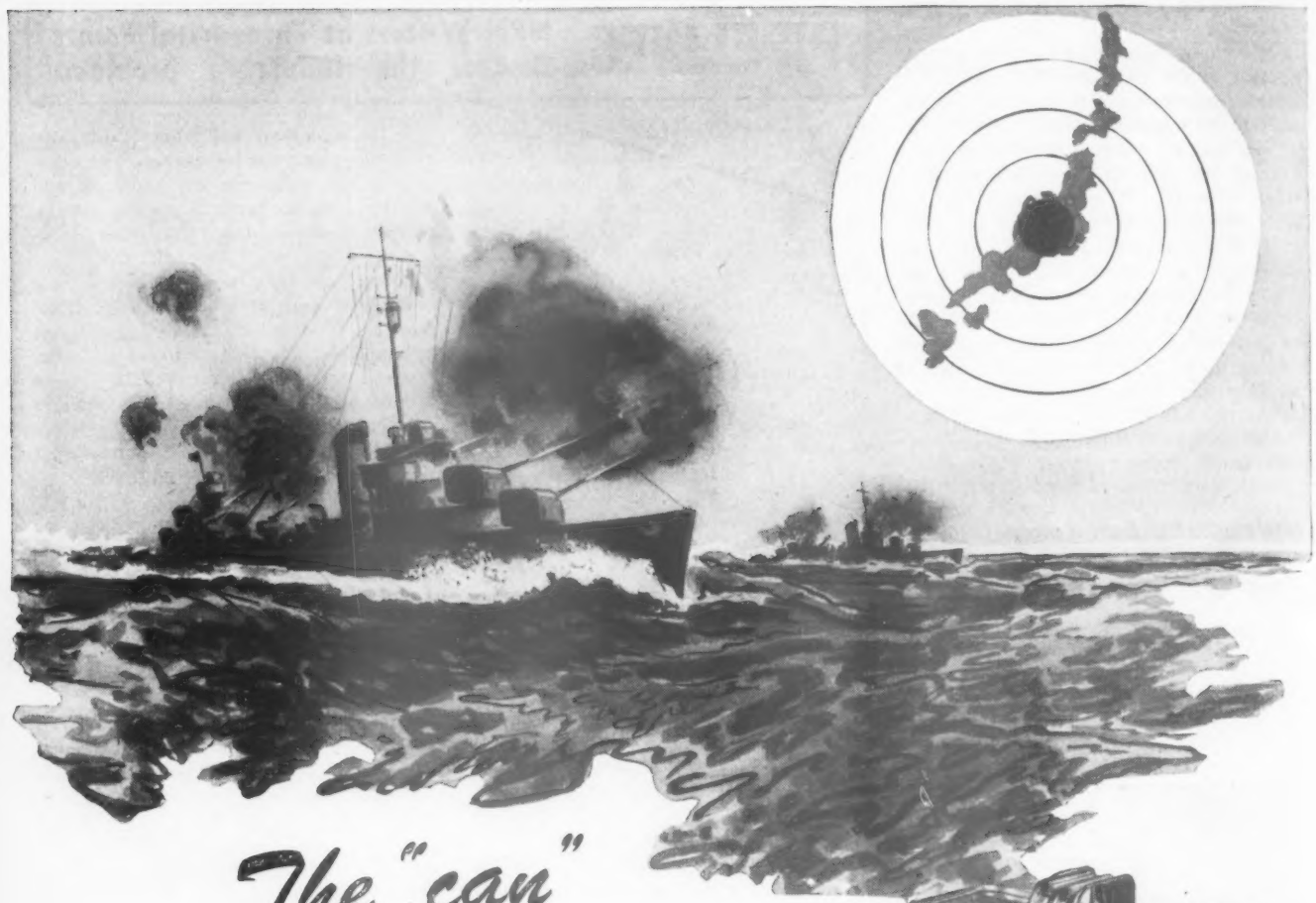
* * *

Oil men visiting Chicago are likely to find more hotel rooms available beginning next month as the Congress Hotel is being readied for civilian occupancy. Manager James Lewis Smith last week said that he was "shooting for an opening date of Aug. 1" for 500 rooms in the south building. Tentative reservations are now being accepted. The remaining rooms—nearly 500—will be opened later.

* * *

Pencils are being sharpened and PAW directors and industry committee men are staring at white sheets of paper in customary author fashion, trying to figure out where to begin writing down the combined PAW and industry war history, a copy of which is to go into the official archives at Washington for the perusal of posterity. It is one record that is sure to be of military value if a monkey wrench gets in the peace machinery now being manufactured.

Preparation of the over-all history is under direction of Dr. John W. Frey, special assistant to Ralph K. Davies. On the Dist. 2 Advisory committee are E. G. Seubert, chairman, B. L. Majewski, Frank Phillips, O. D. Donnell, K. S. Adams, R. R. Bay, P. G. Blazer, Harold B. Fell and A. W. Peake. A. C. Sailstad is chairman of the Working Sub-Committee. Others who will assist him are W. K. Tell, R. F. Hamilton, L. E. Harmon, H. H. West and H. P. Reynolds.



*The "can"*

## THAT PACKS A SHELLACKIN'

THE lethal qualities of the United States destroyer, as of all our naval craft, have made a lasting impression on the Japs.

Shellac plays an important role in helping to maintain this deadliness. Shellac increases the effectiveness of electrical insulation, helps to protect guns and ammunition against harm from salt air and water, affords equal protection for thousands of peacetime products.

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★ ★ ★ CROWN CAN ★ ★ ★

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# To Enlist Industries in Peace-Time Plans Against War

WITH THE BIG JOB OF PETROLEUM SUPPLY for this war about completed, the several military agencies and groups that have had to do with such supply for these war years, are now working rapidly for a keener understanding and a better handling of these problems for the next war, if there is one.

The great importance for this immediate development of a petroleum supply plan lies in the facts that any war for many years to come will undoubtedly be largely an internal combustion engine or oil jet or oil turbine war; that half of the maintenance tonnage overseas for this war consists of petroleum products; and that oil products must be handled in their own facilities and equipment and by men who have been trained for years with these facilities, and that only trained oil men can efficiently install such equipment.

The immediate and latest official action toward special and better handling of petroleum war products, is the consolidation last week of all Army, Air Corps and Navy purchases of all petroleum products and containers under one central purchasing agency and located in one headquarters at Washington.

With this comes the decision to continue the Army-Navy Petroleum Board as the over-all military authority on all petroleum matters and to transfer to this board and its staff the regular service officers of Army and Navy who during this war have had actual experience with the military oil problems. These regular service men are being brought in as rapidly as possible to succeed the oil industry men who are returning to their companies. Perhaps as early as this fall a fair amount of this transition will be apparent to the industry.

But in addition to this and looking far to the future, is the proposed organization of an "Industrial Staff" for the Army on which will be represented all important war industries. This staff will have relatively the same status in war preparations as the "General Staff". The "Industrial Staff" will study and plan the mobilization of all industry just as the "General Staff" plans the mobilization of the fighting units. Brig. Gen. Donald Armstrong, for the Army Industrial College, at the invitation of Chairman Boyd, has already addressed the members of the P. I. W. C., just as he has addressed similar groups from other leading industries the past few months. Mr. Boyd, as president of the American Petroleum Institute, has also canvassed other leading Washington as well as oil industry authorities on how best to develop future oil industry co-operation with the military. The Army is anxious to push the subject while men's recollections of the problems of this war are still vivid.

Another influence in support of the foregoing ideas, will be the oil men who have been serving in Army and Navy both overseas and here at home. They now are returning to civil life with quite definite ideas of the tremendous fundamental importance in all military operations for years to come, of petroleum.

These oil men believe that there must be continuing planning on oil supply and handling and personnel all through peacetime to insure the best military results in the event of another war. These returning oil officers are talking of organizing a Petroleum Military Club, perhaps under the auspices of the A. P. I., where they can record their ideas and develop recommendations to the oil industry and to the military authorities on future oil-military operations.

The writer found this idea quite generally discussed by oil men during his recent nine months stay in the European Theater of Operations. The writer not only felt so strongly for continuing oil industry planning against another war, but he found such deep-seated sentiment for it among the oil men overseas that he has been submitting the idea of continuing industry war planning to top oil executives the two months since his return.

While the Army instituted its Industrial College in 1924, it was operated more as a means of teaching Army officers the problems of supply and of procurement from industry than teaching industry leaders the problems of war and of military supply.

However, the college provided an over-all plan for mobilization for this war that greatly expedited the war effort. But in that industrial planning motor fuel was largely overlooked because, as the saying goes, the oil companies supply services had been too efficient in that all an Army unit on maneuvers had to do was to phone a few oil companies and order the fuel for a certain point at a certain time and it was always there. The vast volume of petroleum products needed for this war had not been appreciated until after we got into it.

To eliminate some of the confusion that came onto the military authorities so unexpectedly, Admiral A. F. Carter, former Annapolis man and for a score of years a prominent oil executive, returned to the Navy as a Captain and with Brig. Gen. Walter B. Pyron, also a former oil man, recommended the centering of petroleum problems that could be handled jointly, such as planning requirements, allocating products and shipping facilities, in a joint Army-Navy Petroleum Board. The recommendation was immediately adopted and Admiral Carter was made chairman of the Board.

### *International Organization Is Developed*

From this he developed a world-wide organization that kept Washington in intimate touch with all petroleum problems and, through the co-operation of war theater commanders, acted in some regards, practically as operating agencies. The result has been that Washington has known to a barrel what the requirements would be even four months in advance and it has known to a barrel all shipments and stocks in all war areas.

Then a "Fuel and Lubricants Section" was created to handle all petroleum problems, supply, containers, shipments and specifications, for all Army agencies except the Air Forces. This was placed in the Quartermaster's department under the charge of Maj. Gen. W. E. R. Covell, former West Pointer, who had been managing a big timber and development company in Arkansas for many years. While Gen. Covell was in India, up to a few weeks ago, in charge of all Army Supply Forces, this Section was in charge of Brig. Gen. Howard L. Peckham.

Now the over-all thought is to make use of the best minds of those industries that make the greatest contribution to war supplies, not only to obtain the most efficient mobilization for war but to make full use of the industry's management skills and place them within the Army and Navy organizations.

Everything up to the actual fighting line today is merely a diversion of peacetime industrial services from civilian consumers, to wartime military consumers.

In oil, for illustration, operating tankers, tank cars, tank

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

trucks, filling and moving 5 gal. cans and 55 gal. drums, pumping fuel into motorized equipment and into air planes, building storage tanks and laying pipe lines—all these are normal oil industry activities in which the industry has trained hundreds of thousands of men how to do them most efficiently.

Therefore, it is argued, the military authorities could well use industry's machinery and industry's personnel by transferring parts of that machinery to war purposes, than to try and create brand new machinery largely from new personnel.

It is to these ends that military leaders today are directing their efforts in the hope that our preparations for war will be so formidable in size and efficiency as to deter any nations from starting another war.

° ° °

## *Time to Check Facilities*

The distribution end of the industry has gotten along for so many war years with make-shifts and by stretching the life of present equipment that some may have forgotten what is good practice and what is necessary for safe, efficient handling of oil products through bulk plants, trucks and service stations.

Now that there is some hope of making equipment replacements and oil distributors are getting their houses in order for the increased competition of postwar years, it is a good time to take inventory.

To help oil distributing companies check their bulk plants, trucks, transports and service stations and all equipment therein, NPN this week introduces the first of three new check lists. (*See p.* 19). These lists will help the distributor to get a concrete picture of the shape his operation is in and can help management to set up its own priorities for the work that needs to be done.

Manpower shortages and wartime restrictions have made many an oil jobber get closer to the operating details of his business than ever before. We know of jobbers who have had to drive their own trucks to make deliveries to their customers in these war days. Most of them had to expose themselves to more direct personal contact with their customers and prospects.

The deficiencies in detail that will need correction are very apparent to these men. Even for them, the NPN check lists will provide a perspective that will give them an opportunity to stand back from their operations and add up just where they stand in relation to where they want to go.

Making an inventory of conditions and equipment—and then correcting the poor spots—is always good business from the standpoint of safety and loss prevention.

### Enjoins Fla. Railroad Comm. Against Any Interference

NPN News Bureau

WASHINGTON—The Federal District Court at Gainesville, Fla., has temporarily enjoined the Florida Railroad Commission from interfering with the gasoline tank-truck business of Miller Motor Line, Inc., Richmond, Va., which curently operates between several Florida points and between Florida and Alabama under temporary ICC authority.

The Florida Commission has challenged the validity of the ICC authority granted to Miller to transport gasoline for the federal government, on government bills of lading, from Port Everglades, Fla., to Homestead Army Air Field, Boca Raton Army Air Field, Miami Air Depot, Miami Army Air Base, and Morison Field, Fla., and Miller went to court. The Commission was given 15 days to show why the injunction should not become permanent.

### OPA Revises Lancaster Plan To Ease Delivery Record

NPN News Bureau

WASHINGTON—OPA is now revising the so-called "Lancaster Plan" controlling non-highway coupon usage to ease the burden of its "delivery record" provisions, and plans a full explanation of the streamlined procedure to all suppliers and farmers.

The main change will be in the wording at the top of the delivery record. Instead of saying that an entry must be made on the record "at the time of delivery," the notation will state that an entry be made "for each bulk purchase." This will mean that delayed recording of the delivery will be possible and that "E" or "R" coupons need not necessarily be obtained from the farmer at the time of delivery. An explanatory bulletin that OPA is putting out will explain that the ration order provides a credit period of seven days on such deliveries.

Thus, the farmer may either pay the tank-wagon driver seven days after the delivery, or deliveries, during that period, or deposit all of his coupons—along with his delivery record—with his supplier who can account for them as each delivery is made.

OPA believes that these changes should remove any lingering objections suppliers may have to the Lancaster Plan.

### Letters

#### 'People Getting Tired'

**FROM: Thos. H. Bennett, South Orange, N. J.**
**TO: The Editor**

I cannot refrain from congratulating you upon the editorial "Price, Not Sufficient Supply, Is OPA's Objective" on page 74 of June 27 NPN. It is by far the best of anything published to date on the subject and most clearly expresses the views of all citizens who are the victims of OPA policy of rotating shortages in order to perpetuate itself.

The people are getting very, very tired of the present nonsensical situation; and if Congress doesn't wake up, will clean house of all present members Democrats and Republicans alike in 1946.

#### 'Grand Statement'

**FROM: E. M. Callis, president Petrol Corp., Philadelphia, Pa.**
**TO: The Editor**

Your editorial in the June 27 National Petroleum News under the caption "Price, Not Sufficient Supply, is O.P.A.'s Objective"—is a grand statement of fact. My company's experience with the O.P.A. during the war economy is a clear example of their objective.

### Sights 2nd Quarter Production Exceeding Previous Records

NPN News Bureau

WASHINGTON—Predicting that production and demand for crude "will exceed all previous records" during the second quarter, the Bureau of Mines said this week that the production of 4,861,300 b/d will be needed to meet the demand in July—a gain of 125,000 b/d or 3% over the same month of 1944.

The Agency noted that data available for May and June indicate that crude production has already increased substantially and that the average demand is approaching 4,900,000 b/d. In April actual crude consumption was 4,793,000 b/d resulting from record production of 4,801,000 b/d and a stock increase of 8000 b/d.

During the first four months of this year, crude production averaged 4,777,000 b/d, up 355,000 b/d or 8% from the same period in 1944. Demand for domestic crude from January through April, 1945, amounted to 4,753,000 b/d, an increase of 257,000 b/d or 6%. During the first quarter of 1945, 24,000 b/d were added to stocks of domestic crude, compared with withdrawals from storage of 74,000 b/d in the first quarter of 1944.

### Lone Star Hearing Is Set

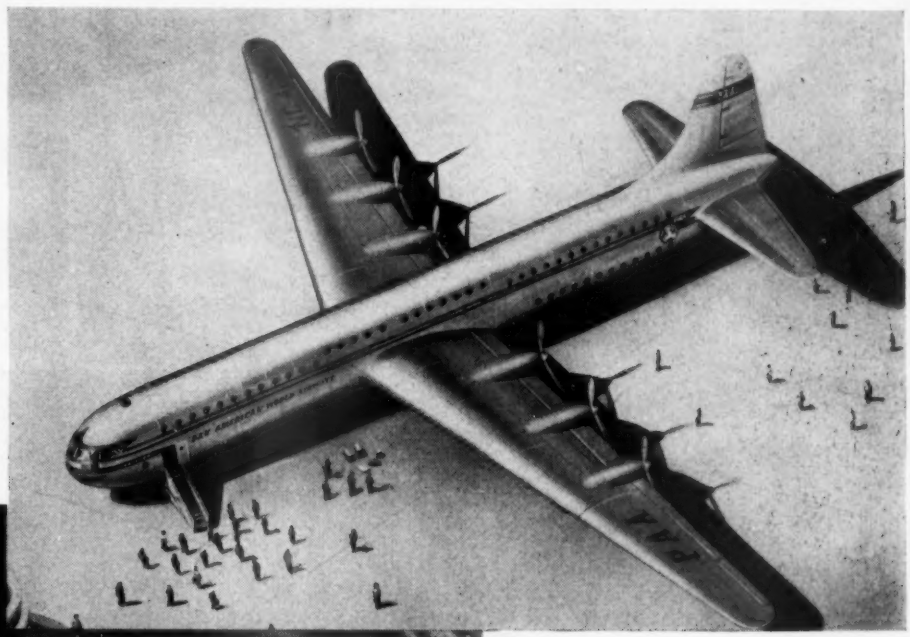
*Special to NPN*

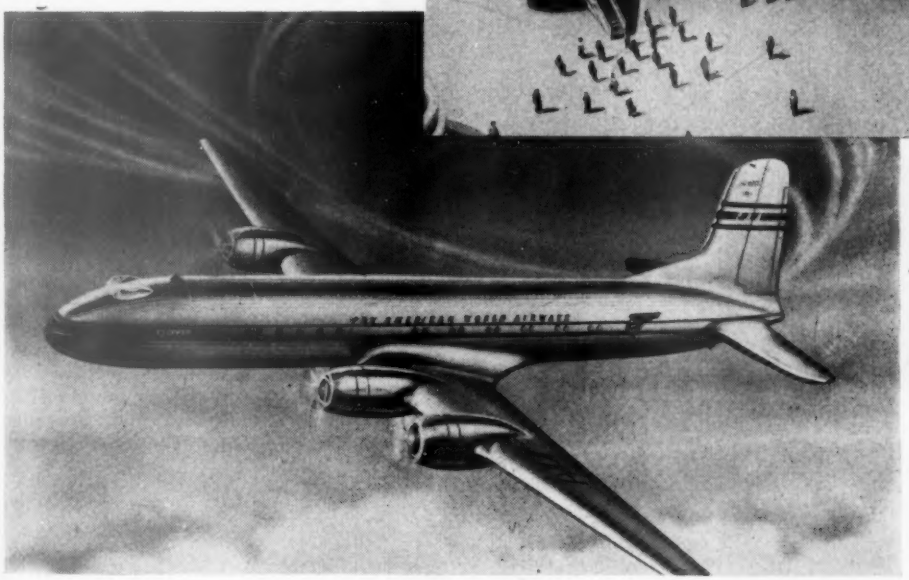
AUSTIN, Tex.—The Texas Railroad Commission has set a hearing for July 12 on the request of the Lone Star Producing Co. for higher allowable for its No. 5 W. H. Grover well in Eastland County.

# Tri-Sure News

NUMBER 31 ★ 30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK ★ JULY, 1945

## THINGS TO COME





### AMAZING FACTS ABOUT THE NEW CLIPPERS

1. There are approximately 25 miles of wire in one airplane.
2. The fuel required to fill the tanks completely is more than the average motorist would use in 20 years.
3. The heating facilities are sufficient to heat a 40-room apartment house.
4. The main landing gear is approximately one foot higher than the average ceiling in a home.
5. The tail extends to the height of a five-story apartment building.
6. The propellers extend higher than a two-story house.

HERE'S a preview of one of the astonishing advances that will mark the era of postwar aviation—mammoth 6-engine clippers that will carry 204 passengers and 7 tons of mail and freight on non-stop flights across the Atlantic!

Pan-American World Airways has commissioned the Consolidated Vultee Aircraft Corporation to construct a fleet of these giant aircraft. In this service, a fleet of only eight planes (supported by three of similar type in the high-traffic summer months) would carry 442,764 passengers annually—67% of the total pre-war passenger traffic moved on the North Atlantic by the ships of all nations. Three of the clippers, at only 50% capacity, would carry 150,106 passengers between Honolulu and California—three times the largest number carried by sea and air combined in any pre-war year. Similar service will be rendered between many American Cities, and between the United States and Latin America.

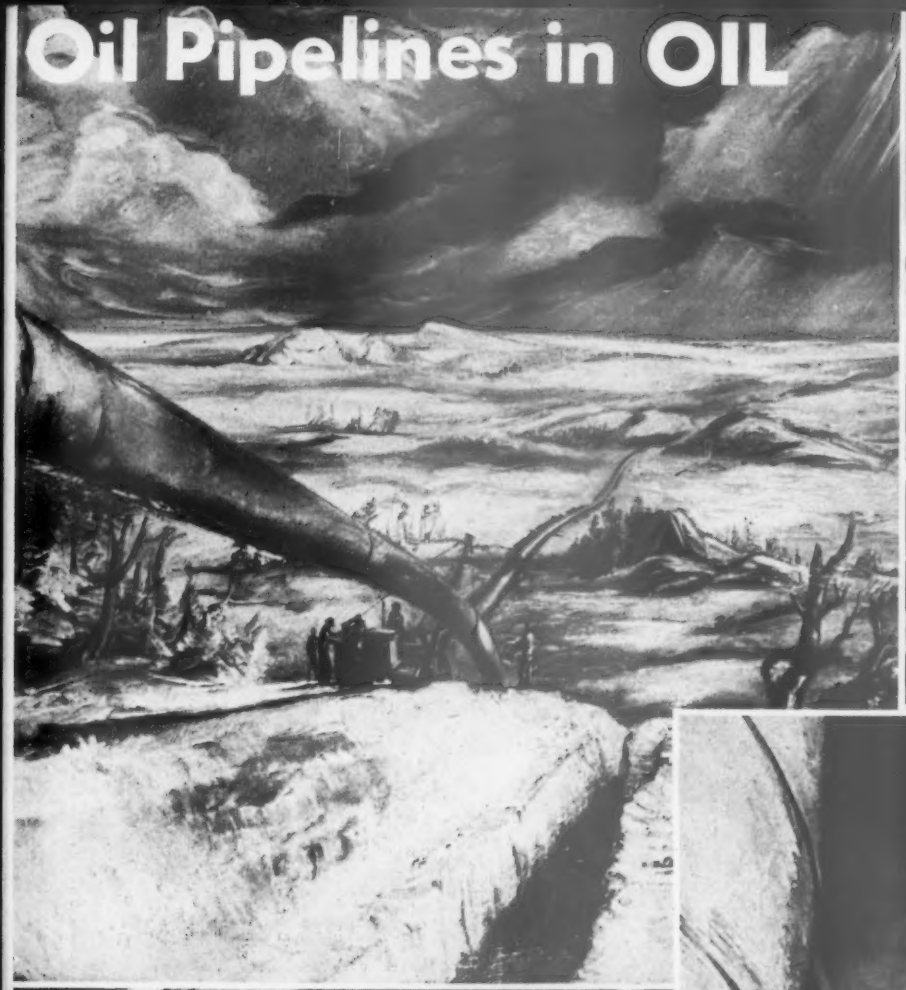
★

Pan-American's great planes of tomorrow will incorporate every device that modern science can contrive to assure the utmost in flying safety and comfort. And playing its vital role as the guardian of the tremendous stocks of oil and gasoline that will power these mighty planes will be the Tri-Sure Closure—an old friend of Pan-American, where for years it has protected drums of fuel from seepage, contamination and leakage.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

# Oil Pipelines in OIL



Oil transportation by pipelines has been dramatized by Frederic Taubes, American landscape artist in his paintings of pipelines and pipeline builders, to be exhibited in leading galleries and schools.

Taubes' canvases show one sequence of the wartime role of oil. His story of oil pipelines in oil depicts in four canvases a story of the part played by pipelines in the war.

They tell the story from the welding of the "big inch" to the final delivery to a tanker on the East coast (upper right). Below, right, is the artist's conception of feeder tanks for the pipelines

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THE SATURDAY EVENING POST
Conditions in the Pennsylvania Oil industry aren't going back to normal right away, of course. There are numerous obstacles remaining to be overcome but skies are brighter now. Difficulties of supply, packaging and transportation, which all of us have struggled against, are bound to ease up soon.
When that day comes, be ready. Be in a strong position to win and hold gallonage with an oil the public wants . . . a 100% Pure Pennsylvania Motor Oil of emblem quality.
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COUNTRY GENTLEMAN
HOARD'S DAIRYMAN
CAPPER'S FARMER
SOUTHERN AGRICULTURIST
THE PROGRESSIVE FARMER
BALANCE
Poised for the plunge, balance is essential. Balance is essential in a motor oil, too . . . balance of all the many qualities an oil must have to protect your irreplaceable car as it should be protected.
100% Pure Pennsylvania Motor Oils of emblem* quality are "balanced" oils. They rate highly on all the points on which oils are compared . . . on all points, not just one or two. It is good judgment and good insurance to use them.
PENNSYLVANIA GRADE CRUDE OIL ASSOCIATION
100% PURE PENNSYLVANIA OIL

For your protection, only oils made from 100% Pure Pennsylvania Grade Crude which meet our rigid quality requirements are entitled to carry this emblem, the registered badge of source, quality and membership in our Association.

**PENNSYLVANIA GRADE CRUDE OIL ASSOCIATION**

OIL CITY, PENNSYLVANIA

# NPN'S CHECK SHEET FOR BULK PLANTS AND WAREHOUSES

LET'S get organized for that "breakthrough" on the home front that will come when petroleum products can again be purchased by civilians under normal conditions, and when materials and equipment will be available for the rehabilitation and modernization of distributing facilities.

Signs are plentiful that, with increased ration allowances of gasoline and heating oils and other products, a period of keen competition for oil distributors will follow.

How are you fixed to get into this mad scramble for business? Is your bulk plant ready? Are your tank trucks ready? Are your service stations ready?

Critical materials are now becoming less scarce. Priority releases are being relaxed, a little now, much more later. As the pattern of military strategy becomes clearer and the end of the Jap war approaches, reconversion will stimulate the production of replacement parts and provide more and more materials for repair first, replacement and new construction later.

With the emphasis on war production during these last three years, our operating problems have been largely those of ingenious make-shift.

We've repaired, patched and patched again. We are so used to doing without, or putting up with half measures that many of us have forgotten what goes to make an economical, safe operation. But we will have to start remembering.

We are the ones that must review, revalue and replace and we must start now. We must find out where we stand, what we need, and decide which items should be replaced first, based on need and availability. Other equipment for the time being at least will have to be repaired and kept in service for some time yet.

The easiest and quickest way to take stock of your own situation is to use check sheets that provide an orderly review of the things that need doing. For convenience these inspection check sheets should be separated into three groups:

1. **Bulk Plants and Warehouses**
2. **Tank Trucks and Transports**
3. **Service Stations**

It is important that the check sheets be convenient and brief, but so complete that a minimum of writing by your inspector will be necessary.

Such a check sheet for Bulk Plants and Warehouses is reproduced here and can be used as follows:

If item is found satisfactory, just mark it (OK)

If item needs attention mark it (X)

As an extra precaution, to avoid the possibility of missing any items that need attention, it is a good idea to put a ring or circle around the item number at the same time you mark it with an X. When an item is "X-ed" it will take the inspector only a moment to make a note of such further information as may be required on the reverse side of the check sheet, numbering the note to correspond with the item number.

Your equipment suppliers can tell you which items of equipment are most readily available. By making full use of their experience and help you can prepare an orderly program and spread the expense over several months and, when that most welcome news of the end of all war comes, you will be ready to go full speed ahead.

And now for details on the bulk plant and warehouse check. First, be sure to fill in the location and name of person in charge of the plant, and then proceed as follows:

## Yard

As we approach the bulk plant our attention is drawn to the condition of the fence—whether the posts are all straightened, no sagging gates, tight barb wire and well painted. We take a look at the general appearance of the yard—no weeds, no tall grass, no rubbish, orderly arrangement of all materials stored outside; all these help to impress our dealers and their customers with our desire to be recognized as a progressive, substantial part of the community.

## Office

Check for dry rot around sash, replace all broken panes, have windows cleaned regularly. Safe for overnight protection of monies should be of chest type, preferably cast in concrete block and so located that a night light will reveal any attempt to prowl or tamper. Lockers should be periodically checked to insure against fire hazard. Oily rags should never be allowed in lockers. Employe-employer relations may be improved by greater attention to the sanitary conditions you provide.

Be sure to take full advantage of those

## First of Series on 'Preparedness'

This is the first of a series of articles on how to get equipment and buildings ready for competitive postwar operations.

Written by an oil man with long and successful experience in maintenance and low-cost operations, the ideas presented are practical and to-the-point.

The accompanying article on BULK PLANTS and WAREHOUSES will be followed by two more—one on TANK TRUCKS and TRUCK TRANSPORTS, one on SERVICE STATIONS.

With each article there will be a Check Sheet—arranged for convenient, efficient and thorough checking of the items that are essential to good operations.

The check sheets will be reprinted and made available to NPN subscribers upon request; from one to five copies, of any one set, no charge; six or more copies of any one set, five cents per copy.



DETROIT PUBLIC LIBRARY

intangible good impressions that are made by clean and orderly surroundings.

## Warehouse

Check foundations for signs of weakness, failure. Make sure rest of structure is sound and serviceable, well painted to prolong life, windows tight, broken panes replaced, leaks repaired. Now may be a good time to study your entire oil storage problem if you converted from canned oil to bulk. If cans are coming back reasonably soon perhaps you should not attempt too much improvement on your bulk storage.

Handling equipment of all kinds should soon be available in better supply. Besides the careful servicing of present units it might be well to have more complete studies made of your entire storage and handling procedure. One company spent $5000 for conveyor machinery and saved more than that in salaries alone the first full year of operation. It paid to hire an expert for that study. Anything that may be added to your warehouse facilities that results in more production units per employe should justify your attention, now.

Equally important is the arrangement of merchandise in your warehouse; proper stacking, accessibility, aisle space and shelving should be studied.

Check over your loading platform to make sure it is of proper height, solid construction with smooth platform working space. Be sure to give consideration to shipping and receiving facilities.

**Loading platforms should be checked to make certain they are of proper height, of solid construction and with smooth working space**

In everything we undertake in the oil business we find Safety precautions and regulations designed to protect life and property. Many simple things may be done at little expense which can pay off handsomely, particularly in the fire prevention field. One small item is proper disposal of oily rags.

An underwriter-approved spring-top safety can in which to deposit oil soaked rags during the day's work is relatively an inexpensive item. It should be the rule always to empty the safety cans each evening and either burn or launder the contents immediately.

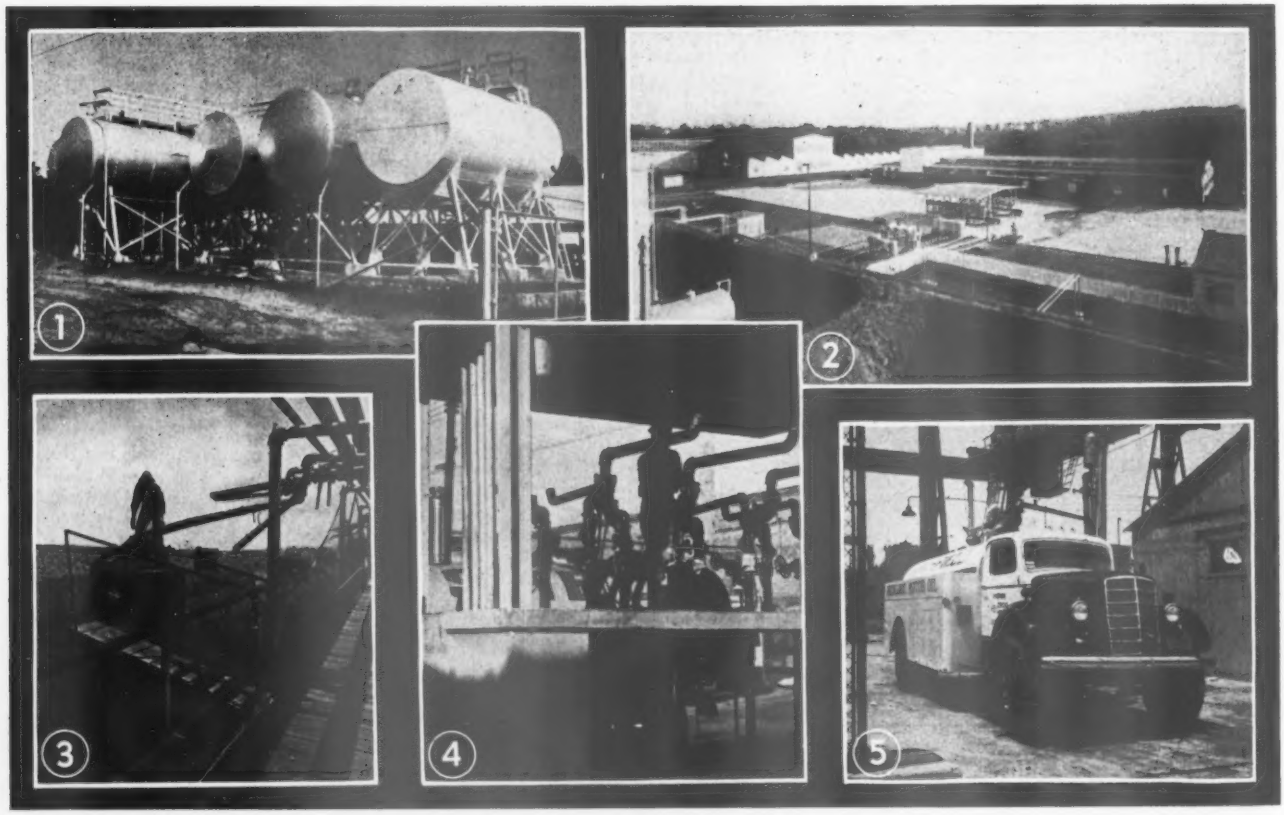
Speaking of fire, be sure to study your fire protection setup, make sure your fire extinguishers are properly located with relation to the inherent hazards. Leading fire prevention experts suggest that all fire extinguishers of liquid types be fully discharged once each year as one way to make sure the devices are in proper working condition. This practice also provides an excellent opportunity to show employes the proper methods to follow in using the various kinds of fire extinguishers.

## Tanks

Check foundations carefully for cracks or other signs of weakness. Where sand or crushed stone mat is used under vertical tanks, be sure the mat is slightly larger than tank. Check to see that tanks are level. Off level tanks will produce false inventory figures and make it very difficult to determine the efficiency of your plant operation. Tanks should not rest on wooden cushions. The wood retains moisture and thus hastens rust, pitting, etc.

Each tank should be separately grounded as one means of meeting lightning

# Checking of Equipment is Simplified With Proper Forms




**1. Even in a small bulk plant like that shown here many items should be checked for repair or replacement so that the jobber will be all set to go when peace finally comes. (2) Checking matters that need attention in a large plant such as this will be simplified by using the forms which accompany this article. (3) Loading and unloading platforms should be carefully inspected for defects. (4) Loading platforms on which a worker may move from one load arm to another without too much dodging is a valuable asset. (5) A little paint, a few metal tags don't cost much but are effective in protecting customers and seller by properly identifying products**

# QUALITY PETROLEUM PRODUCTS

**Industrial Petroleum Naphthas***

*Gulf Stoddard Solvent*
*Gulf V. M. & P. Naphtha*
*Gulf Naphtha E*
*Gulf HS Solvent*
*Gulf Solvent BT*

**Lubricating Oils and Greases**

*Industrial*
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**Petrolatum**

**Refined Wax**

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*A complete line of quality petroleum products*

*If you have not received your copy of Gulf's sixty-page booklet, "Industrial Petroleum Naphthas," write today to Gulf Oil Corporation, Gulf Refining Company, 3800 Gulf Building, Pittsburgh 30, Pennsylvania.

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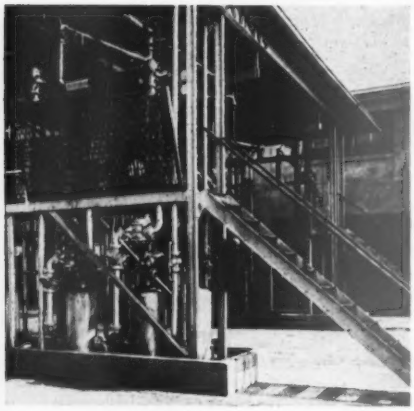


**Stairways are among the items that should be checked in looking over the safety angles**

hazard and also as another step in the effort to combat static electricity about the plant.

Carefully note all signs of leaks. Remember the tank does not have to be very wet at all times to lose considerable product in the Class 1 group. Use soap bubble test on top manholes. Where cone roofed tanks reflect excessive losses the soap bubble test on roof seams may surprise you. This same test may be used to detect leaks on various conservation devices also.

Ladders and catwalks should be of steel. You should plan now for prompt replacement of wooden ladders and catwalks just as soon as materials are made available. Be sure that catwalks are properly installed, firmly anchored and that they permit your men to reach all necessary points. Human life is precious.

Regulations governing dike capacity, type of dike construction, etc. are generally set forth in the various state fire marshal's rules and regulations. Many cities also have adopted ordinances or regulations on the same subject. If you have any question regarding possible violation by your plant better check with the proper city or state authorities.

## Pump House and Pumping Equipment

If you are one of those guilty of using the same piping or a single pump for the handling of both Class 1 (gasoline) and Class 3 (kerosine, etc.) liquids better plan now for the complete separation from point of unloading to the point of loading. You'll sleep better and the cost of the change will be an excellent investment.

Motors of all kinds about a gasoline plant should be individually grounded by a lead wire of adequate size (about No. 6 copper) fastened to frame of motor and attached to ground rod driven at least 4½ feet into the ground. This is another static elimination item and should not be confused with the grounding of lead-in wires and panel board usually made by the electric power line men.

Where belts are used be sure a static eliminating device is installed to bleed off the excessive static charges.

All pumping and other electrical equipment, magnetic starters, motor watchmen and switches should be explosion proof and preferably of the oil immersed type. Where motors are not explosion proof they should be separated from pumps by a vapor proof shield. Switches and starters other than explosion proof should be installed above the generally accepted vapor danger line, at least five feet above the ground. These simple safeguards have been ignored too many times and as a result our industry has had some sad fire experiences.

If pumps leak, look for worn shafts or glands that need repacking. Worn shafts may be replaced fairly readily now, we are told.

**Fire extinguishers should be properly located with regard to inherent hazards**

Be sure the proper fire extinguishers are accessible.

## Loading Rack

A little paint, a few metal tags, are inexpensive yet so effective in protecting your customers and yourselves by properly identifying the products dispensed through your loading rack.

It should be apparent to all that a load platform where the loader may move from one load arm to another without too much dodging will be a valuable asset.

Give your loaders good tools to work with and ample room to work and you will find that more care will be exercised in the loading operations and your handling losses will be much lower.

Be sure all swing joints are operating freely and are properly lubricated or packed. Maybe the anticipated throughput will justify replacing old type units with the newer streamlined ballbearing type. This may be the time also to replace the spill-fill slip sleeve with subloading devices on your Class 1 liquids. Most integrated oil companies use subloading devices because the higher cost is regarded as a good investment that pays satisfactory dividends.

Be sure all sources of leaks around the load rack receive proper attention. Stop the leaks and reduce your handling losses.

The loak rack is one of the more important points for static elimination. Good practice is to tie with approved type ground clamps from one outlet pipe to the next using No. 6 copper wire and grounding off your most used line, generally your housebrand gasoline. There should also be connected into this series a copper static eliminator cable of either No. 6 stranded copper or ¾" x $\frac{1}{16}$" braided flat copper cable of sufficient length to attach to the truck tank by means of a copper pinch clip.

Proper fire extinguishers should always be handy to the loaders platform because there are so many possibilities of spills, any one of which could cause a serious fire unless quickly smothered.

How many times have you noticed a smoker unconsciously reach for a cigaret and a match, even when he is in a place where a lighted match is most dangerous? You must remind him constantly. Be sure you have a "No Smoking" sign prominently displayed at the load rack.

Give thought to your meters, they will not last forever. How old are they? And how many million gallons have they measured? How often do you have their calibration checked? Meters are being released in limited numbers now. Maybe you are one of the many who are going to put meter controls to work. Better review your proposals and get your meter expert's opinion on deliveries. It is not too early to get your meter order in the mill.

## Transport Unloading

So you haven't been using your side track for a year or two, but you may find some supplies again moving to your bulk plant via rail. Better give your tank car unloading equipment a thorough overhauling, repack the swing joints, and

**When manpower and materials are available these tanks will be greatly improved by a paint job**

# NPN CHECK SHEET
# BULK PLANTS AND WAREHOUSES

**Location** _____

**Manager** _____

**Checked by** _____ **Date** _____

**CHECK EVERY ITEM**

**Code**

*Satisfactory . . .* OK

*Needs Attention* . X

## YARD

1 Condition of fence: posts____ gates____ wire____ paint____

2 Condition of floodlights____ night lights____

3 Condition of roadways____

4 General appearance: weeds____ tall grass____ rubbish____

5 Overnight parking space for partly-full tank wagons____

## OFFICE

6 Condition of windows: sash____ panes____ clean____

7 Safe: burglar-proof____ right location____ night light____

8 Heater: safe____ right location____ properly shielded____

9 Lockers: enough space____ free from inflammable material____

10 Wash room: clean____ well ventilated____ clean toilet____ clean lavatory____ enough toilet paper____ soap____

11 Suitable drinking water____ fountain____ paper cups____

12 Over-all appearance: clean____ orderly____

## WAREHOUSE

13 Condition of building: foundation____ walls____ floor____ roof trusses____ roof____ gutters____ down spouts____ fire doors____ is floor weight under the load limit____

14 Condition of lube oil tankage: foundations____ piping____ valves____ outlets marked for product identification____

15 Condition of handling equipment: hoists____ barrel trucks____ package trucks____ pallette platforms____

16 Stored merchandise: enough room____ aisles clear____ clean____

## WAREHOUSE, CONTINUED

17 Condition of loading platform (dray): foundation____ floor____ proper height____ bumpers____

18 Fire prevention: oily rag safety-can____ trash can____ fire extinguishers serviced regularly (date last serviced_____)

19 Condition of tanks: properly installed____ level____ sound foundations____ supports____ manhole covers tight____ seams tight____ rivets tight____ paint (date last painted_____) condition now_____

20 Ladders and catwalks: anchored____ safe____ firm hand rail____ cages (on ladders above 20 feet)____ can operator gauge all tanks from catwalk_____

## TANKS

21 Are tanks individually grounded____ connections tight____

22 Emergency valves: inspected regularly____ fusible links____

23 Outlet valves: operate freely____ free from leaks____ can they be locked____

24 Vents: screens clean____ valve seats clean____ free from corrosion____

25 Anti-freeze valves: properly installed____ operate freely____ free from leaks____

26 Gauge hatches (Class 1 liquids): vapor tight____

27 Gauging and temperature reading devices: properly located____ glass clean____ scales clean____

28 Flame arrestors in operating vents and vent lines: clean____

### TANKS, CONTINUED

29 Condition of dikes: free from wash-outs and other break-through hazards____ free from tall grass, weeds, rubbish____ steps installed over the dike____

## PUMP HOUSE

30 Condition of building: foundation____ floor____ roof____ windows____ ventilating louvers____

31 Separate pumps and piping provided for complete separation in handling Class 1 and Class 3 liquids____

32 Condition of piping: adequate size____ tight fittings____ clean____ all valves marked for product identification____

33 Motors: well grounded____ (if not explosion-proof) is a vapor shield provided between motors and pumps____

34 Electrical starters and switches: clean____ conveniently located____ safe (explosion-proof or installed more than 5 feet above the floor)____

35 Condition of pumps: free from leaks____ do not run hot____ suction-line strainers clean____

36 Condition of lights: vapor-proof____ enough light____

37 Fire extinguishers: proper type____ readily accessible____ serviced regularly (date last charged____)

38 Are "No Smoking" signs prominently displayed____

## LOADING RACK

39 Condition of platform: safe____ enough room____ steps____

40 Condition of piping: clean____ free from leaks____ properly grounded____ valves marked for product identification____

41 Condition of load arm assemblies: valves____ swing joints____ loading hoses____ slip sleeves____ counter balances____

42 Condition of meters: air release____ strainer____ free from leaks____ clean____ conveniently located____

43 Is loading spot level____

44 Static elimination: all outlet pipes electrically connected and grounded____ is tied-in static

### LOADING RACK, CONTINUED

eliminator cable and pinch clip in good condition____

45 Fire extinguishers: proper type____ readily accessible____ serviced regularly (date last serviced____)

46 Are "No Smoking" signs prominently displayed____

## TANK CAR UNLOADING

47 Condition of railroad siding: level____ rails, ties, ballast regularly inspected by railroad (date last inspected)____ are insulating joints in good condition____ bond connections tight____ ground connections tight____

48 Are unload pipe ground connections tight____ static eliminator cable and clip in good condition____

49 Condition of unloading equipment: swing joints____ valves____ free from leaks____

50 Separate stands and piping provided for Class 1 and Class 3 liquids____ all properly marked for product identification____

51 Is "Tank Car Connected" sign available and used____

52 Is canvas dome cover in good condition____

## TRANSPORT UNLOADING

52 Is level spot provided for checking receipts____

53 Are unload pipe ground connections tight____ static eliminator cable and chip in good condition____

54 Separate pipes provided for Class 1 and Class 3 liquids____ all properly marked for product identification____

## GARAGE

55 Condition of building: foundation____ floor____ roof trusses____ roof____ windows doors____

56 Condition of air compressor: safety valve____ moisture drain cock____ compressor hydrostatically tested regularly (date last tested)____ explosion-proof motor____ belt in good condition____ static eliminating device on belt____

57 Are lighting units and switches vapor-proof____

58 Is proper space provided for storing spare tires____ tire chains____

# A Check-up on
# THE HEART OF POSTWAR REMODERNIZATION
# . . . the Fluid "Cat-Cracker"

THE WAR RECORD of refining shows that more than two-thirds of all catalytic cracking capacity built since the beginning of the war employs the *Fluid* process. Further, fresh-feed statistics show that *"Fluid"* now comprises more than 50% of the nation's total catalytic-cracking capacity.

Among its outstanding advantages for postwar production are . . .

1 . . . **Maximum yields** of high octane gasoline components and convertible gases. Typical basic yield: 30 degree *wide* cut gas oil feed . . . 45% of #10RVP 400 end point gasoline with a rating of 82.0 clear CFR-M (94.5 clear CFR-R).

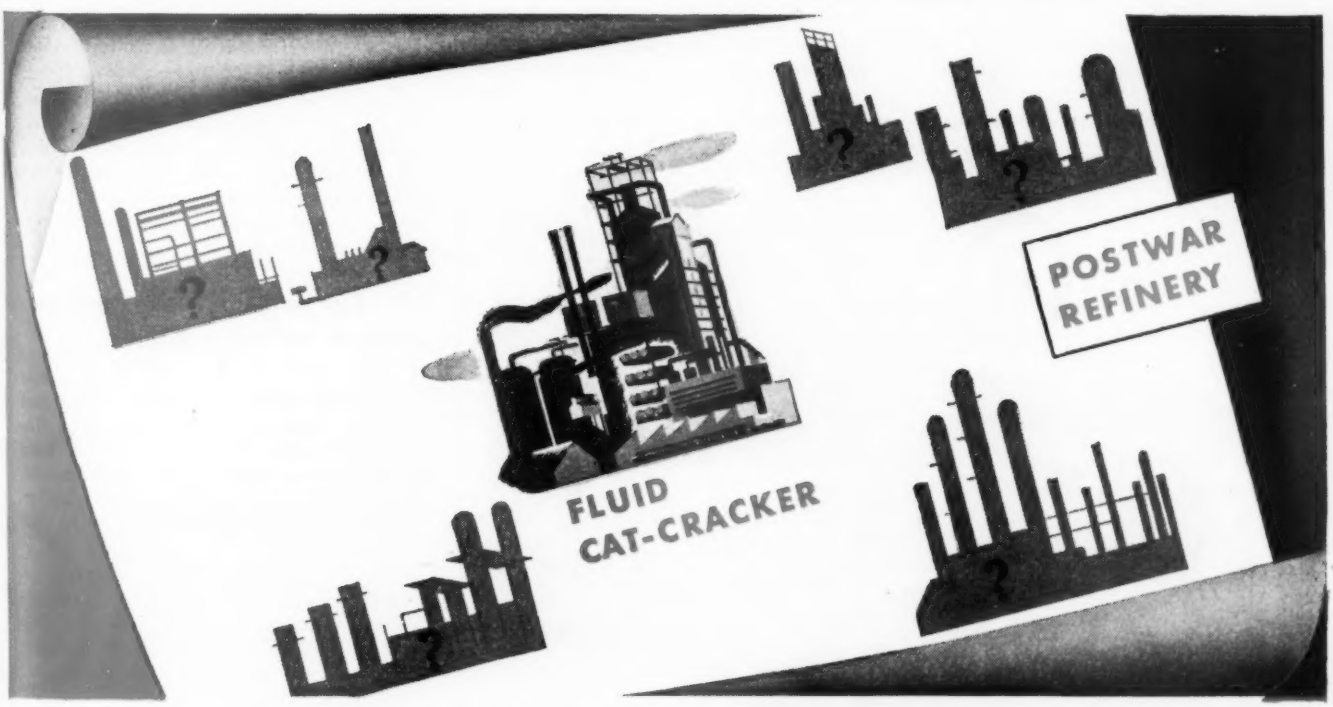
2 . . . **Widest variety of feeds** . . . ranging from light gas oil to reduced crude . . . can be utilized.

3 . . . **Continuous operation.** Records of Kellogg designed-and-built *Fluid* "cats" show a continuous operation of more than 300 days . . . with no physical need for a shut-down yet in sight! This radical increase in "on-stream" time of cracking facilities shows up directly in profit statements.

4 . . . **Extreme flexibility** of operating conditions. To meet a wide range of market demands, the ratio of catalyst-to-oil can be varied as high as 20-to-1, permitting control of heavy fuel oil production from crude.

5 . . . **Economy of operation.** Compared with either thermal or other catalytic-cracking, *"Fluid"* proves outstandingly superior. For instance, with any but the lightest gas oil feeds, the heat generated is sufficient to supply all fuel and steam utilities in addition to cracking.

But perhaps the greatest overall advantage of the *Fluid* catalytic-cracking process is its adaptability for units of all sizes—Kellogg designs range from 1760 bbls. to 35,000 bbls. per day. Kellogg process engineers—so intimately connected with the development of the *Fluid* process from its pilot plant stages to commercial operation—will be glad to demonstrate how effectively a *Fluid* unit can fill the center of your remodernization plans.




# THE M. W. KELLOGG COMPANY

***Engineers and Economists to the Petroleum Industry***

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valve glands. If your railroad inspector has not checked your side track, ties, etc. better call him in so you can be ready. You may need to do some pipe work to get proper separation of Class 1 and Class 3 liquids.

The engineering department of your railroad will gladly quote on installation of rail bonds, grounding, and insulated joints. It is generally considered good practice to have the railroad also attach pipe clamps to the pipe unload stand and connect by copper grounding cable to the ground rod used for grounding side track. Where this is not done you should be sure to ground the unload stand independently.

Without doubt some products will continue to arrive via truck transports. Perhaps it may be well here to remind all concerned that the procedure in checking receipts via transport is the same as for tank car receipts. You will note we have stressed the importance of a level place at the plant to enable your yard man to properly check each compartment loading.

Your facilities should be as convenient as possible and be protected by proper grounding at the unload pipes. In addition a static eliminator cable should be hooked into the unload pipe grounding system, this should have a clip for attachment to the transport tank during entire unload operation.

## Garage (Truck Storage Only)

Check condition of building, and equipment. Make sure your garage doors are wide enough so that drivers can back their trucks into stalls easily. It is good practice to park trucks facing toward the doors so they may be pushed out in any emergency. Another common rule is that only completely empty trucks may be stored inside overnight.

These are some of the more common points to be considered in connection with a well organized bulk plant for the job we expect will be required of us. Much of it is old stuff to many of you, but like everything else we sometimes forget. These check sheets may help you to remember.

Like most all forms of survey, inspection check or audit you can get a lot of good or just not much of anything from these sheets depending on your interest in the problem. Try to impress on your inspector the need for careful, thoughtful study of each item. Have him supplement the check with notes on all suggested improvements.

Lastly, take time to review, (in detail) the inspector's report and get your program organized. Call in your suppliers and let them help you line up your needs and the probable order of availability. In other words set up your own priority system to provide a program for replacement and repair, spread over several months.

**Next: Tank Truck and Transport check sheets.**

## Sights No Shortage of Tires To Hamper Autos After War

*Special to NPN*

NEW YORK—"*Ethyl News*," a publication of the Ethyl Corp. in a recent edition said tire conditions would not hamper postwar rehabilitation of automotive transportation.

Predictions have been made in the rubber industry that neither the quantity nor the quality of synthetic tires will prevent full restoration of motoring, and that driving speeds, annual mileages or gasoline consumption will not be restricted.

This forecast, applying to all types of vehicles, assumes that for some time after the war with Japan is over the burden of tire supply will fall mostly on synthetic rubber, it is explained.

James J. Newman, vice president of the B. F. Goodrich Co. has been quoted as saying: "It is highly impropable that any restrictions on the number of cars in operation, on the miles per vehicle which they travel or on the speeds at which they travel will be imposed by tire supply limitations.

"Some tightness may exist for twelve to eighteen months following the end of hostilities but should not continue longer," Mr. Newman adds. "It is our opinion, therefore, that the volume of gasoline sales will not be materially affected by tire shortages."

Mr. Newman cites the greatly expanded fabricating capacity of the tire industry that will be available for postwar civilian needs. This enlarged unit capacity will prevail, it is said, despite the limiting factor that synthetic rubber is characteristically hard to handle, for it takes as much equipment and manpower effort to process 750,000 tons of synthetic as it does to process 1,000,000 tons of natural rubber.

Taking into consideration only the capacity authorized and building before Dec. 1, 1944, Mr. Newman continued, it is estimated that the industry can provide 96 million tires a year, of which 74 million may be passenger car tires. The additional capacity since authorized will increase both of these totals.

Responsible authorities agree, however, that to keep the nation's automotive system going, it will be highly essential for the motoring public to continue to observe wartime tire conservation measures completely and to make full use of recapping facilities.

## Wheeling Up Extra Fuel Tank for a B-29

**These three Yanks wheel a huge gas tank toward a B-29 Superfortress which will supplement the plane's usual supply of fuel to enable it to make the long flight against the Japs from its base in the Pacific**

## Air Patrolman Keeps Pipeline Spotted For Leak Repairs

NPN News Bureau

CLEVELAND—A recent issue of *Pegasus*, monthly publication of the Fairchild Engine & Airplane Corp., told an interesting story of the daily patrol along a 550-mile pipeline which carries natural gas from Monroe, La., to St. Louis.

When a leak is spotted, Joseph Sleboda, the patrolman, writes a message which he drops in a container to the nearest of seven equally spaced stations along the line, from where a repairman goes out to stop the leak. In many cases the damage is repaired before a foot patrolman would have had time to reach the pump station.

Sleboda has become so accustomed to his job that he can spot a leak merely by the discoloration of the grass or foliage, or by bubbles in the water when the line is covered by flood.

# POWERFUL *New* INGALLS SEA MULE

## SAVES MONEY FROM THE START

The illustration shows Sea Mule Model DCQ, deep draft with crew quarters. The craft is 42 feet long, 16 feet wide. Model D, without crew quarters, is the same size and similar in design. Both types are also available in shallow draft models.

Powerful enough to do the work of a river towboat and small enough to get around easily and quickly as a harbor tug, the new revolutionary Ingalls Sea Mule costs less to buy and it costs less to operate.

Factory production of standardized designs effects economies in the initial construction and, with less bulk and weight, this powerful "floating engine" is more economical to operate, whether running free or under load. A crew of only two men can operate this all-steel marine tug efficiently.

The Sea Mule is available in four standard models—deep and shallow draft, with and without crew quarters—which allows owners and operators to select the craft best suited for their particular needs. Five types of power plants (Diesel and gasoline), ranging from 660 horsepower to 164, are available and any of the standard models can be equipped with any set of the propulsion engines. Write or phone your nearest Ingalls office for complete specifications, or to arrange a demonstration.

The Sea Mule has been tested thoroughly and proven in war service and this model of the Sea Mule was built by Ingalls to Navy specifications.

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REFINING NEWS and TECHNOLOGY

## Dist. 2 D & M Committee Will Size Up Shifts in Crude

NPN News Bureau

CHICAGO — Tetraethyl lead for premium gasoline and the outlook for fuel oil for the fall heating season will be principal topics for discussion at the Dist. 2 Distribution and Marketing Committee meeting July 12, according to B. L. Majewski, chairman.

At noon the committee has been invited to attend Chicago Oil Men's club luncheon at the Continental Hotel, where W. C. Platt, editor and publisher of NATIONAL PETROLEUM NEWS, will speak on oil at war in Europe as he found it during his nine months service as a war correspondent. George B. Davies, club president, says that all oil men will be welcomed at the luncheon, whether or not they are members of the club or the D & M Committee.

At the D & M Committee meeting at industry headquarters an attempt will be made to estimate fuel oil supplies after July, as the situation has been materially affected by the cutback, 50,000 b/d to 20,000 b/d, in the 702 Navy Diesel and Pool 21 gas oil for military, and the stoppage by PAW of shipments of about 6000 b/d of crude oil from Wyoming to the Mineapolis area.

## Smoking Rule Rebellion Shuts Shell's Butadiene Plant

NPN News Bureau

LOS ANGELES — Operations at the Shell Chemical Co. butadiene plant at Torrance were suspended last week after approximately 100 operating employes of the plant were dismissed for "insubordination."

Since the plant began operating 18 months ago, it has been the practice for operating employes to receive permission to leave their posts during working hours to go to certain company designated zones where smoking was allowed. This practice was stopped last week and the employes refused to abide by the change.

The area is regarded as highly hazardous. A few weeks ago an explosion and fire occurred at the plant which resulted in injuries to several persons.

# Egloff Predicts that Petroleum and Natural Gas Chemicals Will Surpass Even Coal Tar Industry

NPN News Bureau

CHICAGO — Over a million new organic chemical compounds will likely be produced from petroleum and natural gas in the future, according to Dr. Gustav Egloff of Universal Oil Products Co., speaking before a meeting of the Co-operative Club here last week.

Dr. Egloff

"Petroleum refining is becoming more and more a chemical industry," he stated. "Its tendency is toward the development of specific chemical processes that yied products having precise characteristics."

He predicted that the future petrochemical industry, as it has come to be called, will have infinitely greater possibilities than the industries based on coal tar chemicals. It is estimated that coal tar has served as a source of about 500,000 derivatives.

Dr. Egloff explained this greater potential of petroleum and natural gas over coal tar on the basis of the difference in the chemical composition of the two raw materials.

Coal tar hydrocarbons are mainly "aromatic" in character; that is, they are all based on the hydrocarbon compound, benzene, which is characteristically composed of six carbon atoms linked one to the other to form a closed ring.

Natural gas and petroleum, on the other hand, are composed not only of aromatic hydrocarbons but also of what are known to the organic chemist as "aliphatic" hydrocarbons. Molecules of aliphatic hydrocarbons are made up of a string of carbon atoms linked together in chain-like fashion, in contrast to the closed ring of the aromatic compounds.

It is this basic difference between the two types of hydrocarbons (the closed-ring aromatics and chain-like aliphatics) which accounts for the greater possibilities in the petrochemical field. With any given number of carbon atoms, it is possible to have many more aliphatic compounds because of the chain-like structure and the possibilities of branching off on the sides of the chain. Dr. Egloff pointed out that over four billion aliphatic hydrocarbons are possible with 30 carbon atoms.

Many synthetic products produced from original petroleum fractions, as well as derivatives produced by the use of specific reagents, are now on the market in commercial quantities. According to Dr. Egloff one company is now producing over 100 products, including 24 alcohols, 4 ketones, 23 esters, 13 amines, and 35 other compounds.

The products derivable from petroleum sources are many and various. Included are high antiknock hydrocarbons for aviation fuels, rubber bases, solvents, insecticides, fungicides, disinfectants, resins, flotation agents, fertilizers, detergents, cosmetics, perfumes, refrigerants, combustion accelerators, and anesthetics.

### Sees No Raw Material Shortage

With regard to the availability of raw materials, Dr. Egloff said that "the petroleum and natural gas resources of the United States and Canada are still enormous. There are vast unexplored areas in both countries, which will undoubtedly furnish hydrocarbon materials for many years at a rate far higher than today.

"One may say that our underground gaseous and liquid hydrocarbon resources in North America scarcely have been touched, and that Canada is playing and will play a great role in the future as a source of raw materials for many new chemical industries."

Another reason given for the lack of concern over the availability of raw materials was that these chemical derivatives of petroleum and natural gas, despite their impressive tonnage, represent in reality a very small percentage of the total oil and gas production.

"As of today," Dr. Egloff stated, "the products of the chemical industry founded on petroleum and natural gas, represent less than 1% by weight (of total oil and gas production), and hence there should be no basis for concern about raw materials."

"There is every reason to believe," he concluded, "that the development of special products from petroleum will be enormously enhanced in the postwar era."

## Kentuckians to Experiment On 'Gas' From Shale

*Special to NPN*

LEXINGTON, Ky.—Extraction of oil and gasoline from coal and oil shale is to be undertaken by Prof. C. S. Crouse, head of the University of Kentucky's department of mining and metallurgical engineering. A laboratory factory to cost $50,000 is to be erected on the campus where the "Crouse Process" of low temperature heating will seek to produce a liquid fuel from which gasoline and other oils may be extracted. The process is the reverse of the customary high temperature coking methods, and the plant here is viewed solely as a research project.

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## Rubber Corp. Reports On Five-Year Work

NPN News Bureau

WASHINGTON—The Rubber Reserve Co. this week released a 90-page study of the rubber program between 1940 and 1945, which showed that production of American synthetic rubber now totals approximately 1,400,000 long tons.

In making the report public, S. T. Crossland, executive vice-president of RRC, said that the synthetic production for 1944, 737,000 tons, was greatly in excess of the largest amount of natural rubber consumed in the U. S. in any year prior to World War II. He added that the scheduled production of such rubber for 1946—1,200,000 tons—would exceed the amount of natural rubber consumed in the whole world in any year before 1941.

Statistics in the report cover activities of RRC up to the beginning of 1945, but Mr. Crossland disclosed that the 51 government-owned plants, whose operations are supervised by RRC, produced 378,000 tons in the first five months of this year. Estimated production of 78,000 tons for June will boost the total for the first half of 1945 to about 456,000 tons. Scheduled production for the whole year is approximately 1,000,000 tons.

The report says that in 1944 it cost approximately 31c a lb. to produce GR-S, the general purpose synthetic rubber produced in large volume. That cost was the average for all plants in the program, exclusive of plant amortization and interest charges, program administration and sales expense. The present operating cost at the lowest-cost plant is about 11c per lb.

### Predict Lower Costs

It was predicted that in the post-war era a production cost below that rate can be anticipated.

Regarding quality of synthetic rubber, the report says:

"Performance of tires made from synthetic rubber is now very close to that of the average pre-war natural rubber tire. . . The use of butyl rubber in the manufacture of inner tubes where pneumatic (air retention) properties are important has been successful and is expanding."

A technical mission, which returned from Germany, recently said: "American synthetic rubber, methods of manufacturing it and the products made from it are generally superior to those of Germany."

Mr. Crossland said that was a surprising comparison in light of the fact that the Germans had pioneered in the making of rubber from chemicals.

The report also discusses the problems of acquiring natural rubber and the program initiated by RRC for that purpose which was subsequently transferred to the Rubber Development Corp. It describes by graphs the conversion of the rubber manufacturing industry from the use of natural to synthetic rubber, but it warns that natural rubber is still in short supply and that the United Nations stockpile is critically low.

Concerning the future of the rubber program, the report says:

"The War Production Board has furnished Rubber Reserve Co. with its requirements for synthetic rubber from government plants, which aggregate approximately 985,000 tons for 1945, and 1,176,000 tons for 1946, which is approximately 120% of rated capacity in 1945, and 140% of rated capacity in 1946. These requirements are attributable to the expanded tire program, and are essential to its successful completion. To meet these requirements, it will be necessary, not only that the present facilities be operated at a level far in excess of that heretofore achieved, but also that certain modifications and additions be made to existing facilities at an investment cost of approximately 3% of the present investment.

"It will also be necessary to obtain the necessary chemicals, alcohol, and petroleum feedstocks. Unless the program can retain the technical and skilled personnel it now has, and also obtain such additional personnel as is necessary for the operation of the plants, it will be impossible to produce the amount of rubber required.

"To meet the expanded tire program it will be necessary, in addition to producing large additional quantities of synthetic rubber, to increase supplies of certain important components such as carbon black, rayon and cotton tire cords, and beadwire. The responsibility for the tire program lies in the War Production Board, with which Rubber Reserve Co. co-operates closely.

"Pending liberation of the occupied rubber producing areas and during the time required to bring the plantations up to a substantial percentage of their former capacity, it is anticipated it will be necessary for the U. S. government synthetic rubber plants to operate at a high rate of capacity.

"The results of continuing developments with respect to the utility and cost of synthetic rubber, and the relationship between supply and demand for world needs, will largely govern the future of the industry and the ultimate destination of the government's program after the complete rehabilitation of natural rubber production in the Far East."

## Texas Co. Employes Get Citation

NEW YORK—At a supper here June 25, sixty-one employes of The Texas Co.'s New York offices and Beacon Research Laboratory, Beacon, N. Y., received awards from the Office of Scientific Research and Development in recognition of meritorious work relating to the prosecution of the war under National Defense Research Committee contracts. The awards were presented to the employes by James Tanham, vice president of the company.

## 702 Diesel Cutback In Dist. 2 Forecast

NPN News Bureau

CHICAGO—PAW was involved in much of the news out of the midwest area through the last week with that agency expected to cut back the 702 Diesel and Pool 21 gas oil programs from 45,000 b/d to 20,000 b/d early in July, in Dist. 2. Crude shared by Dist. 2 refiners was lowered by 2910 b/d under PAW authorization. E. J. Bullock, Dist. 2 director of PAW, issued a wire directive to refiners limiting the use of tetraethyl lead to manufacture aviation and three grades of civilian gasoline. Washington PAW is expected to prohibit shipments of crude, residuals and asphalt from Dist. 4 to Dist. 2, July 1, and Petroleum Administrative Letters 68, 69 and 70 were issued during the week.

The expected reduction in the Navy 702 Diesel and Pool 21 gas oil programs of 25,000 b/d is understood to be result of better over-all supply situation and not because of reduction in Navy requirements. The cutback will allow summer stockpile for next burning oil season, which has been badly depleted due to late seasonal demands for burning oil and difficulty in getting replacements for participation in the Navy program.

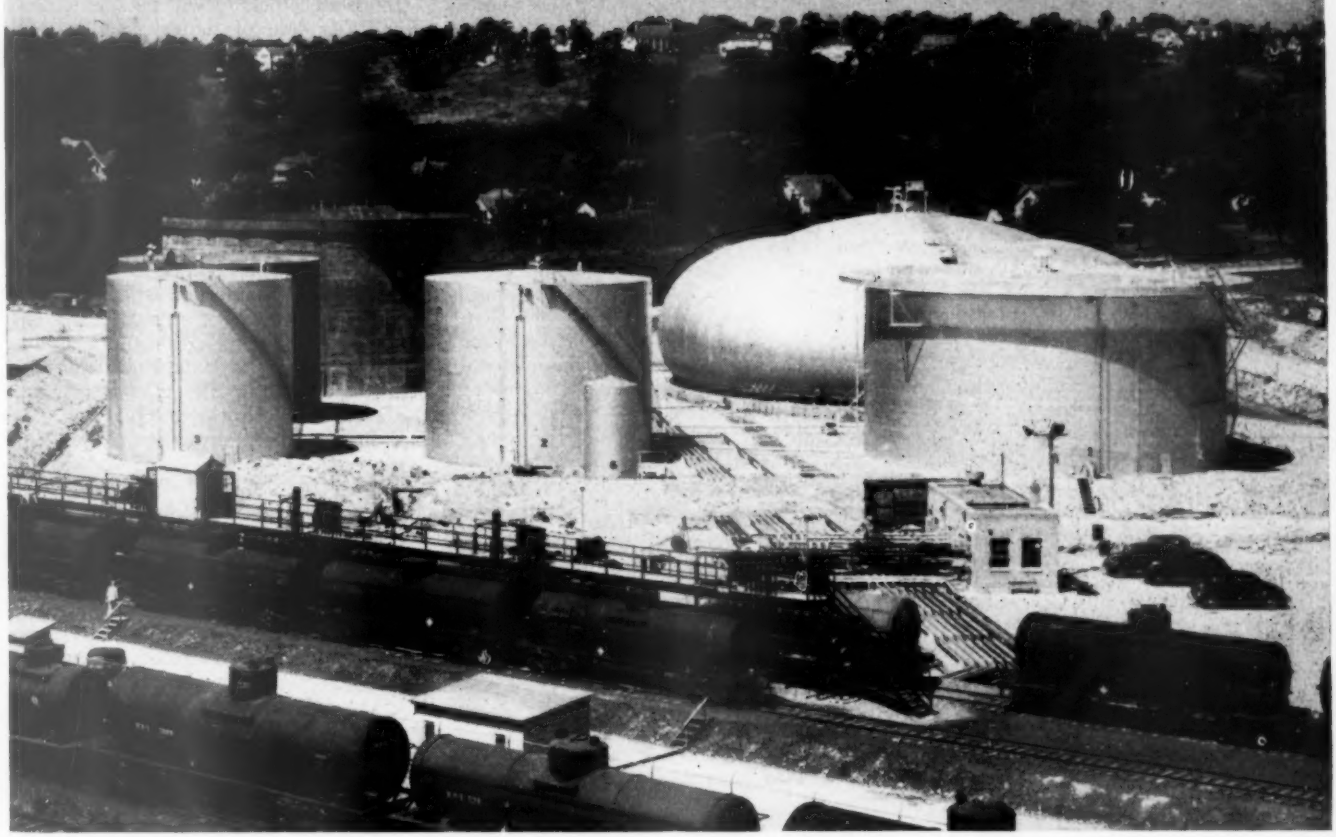
Dist. 2 crude sharing reduction from 11,910 b/d to 9,000 b/d for July is understood to result from several refiners having made their arrangements for crude without applying to the Dist. 2 crude panel.

In wire directive issued June 25, effective that date, PAW restricted the use of tetra-ethyl lead in the manufacture of aviation, premium, regular and third grade gasoline. This does away with the use of lead in naphtha which is being used in blending with natural gasoline to produce premium. Directive also prohibits the use of 87-octane and other lower grades of aviation gasoline as a blended agent to produce civilian premium, and limits distribution to the basis of PDO 21.

Midwest oil men are expecting a directive from Washington PAW to prevent the shipment of crude, residuals and asphalt from Dist. 4 into Dist. 2. Directive is expected July 1 and will temporarily hamper operation somewhat, unless replaced by supplies from elsewhere, probably Dist. 3.

C. C. Brown, Dist 2 director of production, has issued Petroleum Administrative Letters 68, 69 and 70, permitting optional diagonal or center spacing of wells in either the northeast or southwest quarter-quarter section of the West Moore Field, Cleveland County, Oklahoma, effective June 25, and the Hammer Field, Barton County, Kansas, effective June 28. Letter 70, permits optional diagonal or center spacing of wells in either northwest or southeast quarter-quarter section of the Clearwater Field, Sedgwick County, Kansas, effective June 28.

# HORTONSPHEROIDS and WIGGINS ROOFS
## *help prevent evaporation losses at marketing terminals*



MARKETING terminals are the key to the economical distribution of petroleum products. Terminals and bulk plants should have ample storage capacity to take care of the demands of any given area during any emergency. The *kind* of storage facilities, too, is a determining factor in just how efficient and economical any particular marketing terminal can operate.

If the yearly evaporation loss from just *one* tank with a "gas-tight" roof were to take place at one time, you would take immediate steps to stop this waste. Leading marketers are reducing this evaporation loss at their terminals and bulk plants by using Wiggins vapor-saving roofs and Hortonspheroids.

*There are several types of vapor-saving tanks at the marketing terminal shown above. They include a 100,000-bbl. Hortonspheroid, a 50,000-bbl. tank with a Wiggins Pontoon Roof, and a 37,500-bbl. tank equipped with a Wiggins Balloon Roof which is connected to the vapor spaces of three cone roof tanks.*

The table below shows the effectiveness of the Hortonspheroid and Wiggins Roofs in reducing evaporation losses during the storing of motor gasoline. Tank capacities in this table are comparable to those shown in the photo above.

**TOTAL EVAPORATION LOSS IN BARRELS OF 42 U. S. GALLONS**

| CAPACITY OF TANK IN BARRELS | GAS-TIGHT FIXED ROOF | | WIGGINS BALLOON ROOF | | WIGGINS PONTOON ROOF | | HORTONSPHEROID 2½ lbs. Pressure | |
|---|---|---|---|---|---|---|---|---|
| | One Complete Filling | Annual Breatning Loss | One Complete Filling | Annual Breatning Loss | One Complete Filling | Annual Breatning Loss | One Complete Filling | Annual Breatning Loss |
| 40,000 | 80 | 1080 | 72 | 0 | 0 | 280 | 40 | 0 |
| 50,000 | 100 | 1300 | 90 | 0 | 0 | 325 | 50 | 0 |
| 100,000 | 200 | 2200 | 180 | 0 | 0 | 500 | 100 | 0 |

Write our nearest office for quotations on Wiggins Pontoon Roofs, Wiggins Balloon Roofs, Wiggins Breather Roofs and Hortonspheroids.

# CHICAGO BRIDGE & IRON COMPANY

Birmingham 1.....1534 North Fiftieth Street
Houston 1.....5618 Clinton Drive
Tulsa 3.....1607 Hunt Building
New York 6.....3345-165 Broadway Building
Cleveland 16.....2206 Guildhall Building

Chicago 4.....2123 McCormick Building
San Francisco 11.....1160-72 Battery St. Building
Philadelphia 3.....1614-1700 Walnut St. Building
Los Angeles 14..... 1422 Wm. Fox Building
Washington 4.....703 Atlantic Building

Plants in BIRMINGHAM, CHICAGO and GREENVILLE, PENNSYLVANIA

## Texas Commission Is Upheld In Well Spacing Decision

*Special to NPN*

AUSTIN, Tex.—The Texas Railroad Commission's Rule 37 (spacing) permits should be upheld by the state's courts unless they are "clearly illegal, unreasonable or arbitrary" the Texas Supreme Court has written in upholding the Commission in one of the cases.

The Supreme Court upheld a Travis County District Court decision favoring G. M. Potter and Fred Birdsong, who drilled wells Nos. 3 and 4 on an 8.97 acre tract in Gregg County under special permission of the Commission. The decision overruled a Court of Civil Appeals injunction against operation of the two wells.

The complaints were filed by Humble Oil & Refining Co. and Sun Oil Co., which held leases adjacent to the L-shaped, narrow tract on which the wells were drilled.

"The decision in this case may be placed on the rule that if there is any testimony of probative force to sustain the order of the Railroad Commission and judgment of the trial court, it is the duty of the courts to uphold such order and judgment unless they are clearly illegal, unreasonable or arbitary," wrote Associate Justice John H. Sharp in his opinion.

The Third Court of Civil Appeals here meanwhile ruled against M. E. Trapp and for Shell Oil Co. in another Rule 37 case. It involved a small tract of land in the East Texas field on which Trapp sought to drill a second well. Whether the tract contained 1.77 acres or three acres is a matter of dispute in the suit. The trial court was upheld by the appeals court.

## Humble Reworks Tomball Field Gasser and Brings Up Oil

*Special to NPN*

HOUSTON — Reworking of an old gasser in the Tomball field near here has paid off.

It is the Humble Oil A-2 W. Martens, which was originally completed in September of 1934. Drillers have now recompleted the well in five feet of the Petrich sand at 5573-78 feet and brought it in for a 447 b/d oil producer.

Old total depth was 5584 feet. Gas-oil ratio is 725 to 1. Flow is through a ¼ inch choke.

# FPC Maps Ground for Many-Sided Gas Inquiry To Hold Sessions All Over U. S. in Fall

NPN News Bureau

WASHINGTON—A detailed and far-reaching investigation of natural gas resources and end uses, delving deeply into their relationship to crude production, will get underway on Sept. 18 at Kansas City, Mo.

In a 1500-word statement of the procedure to be followed in the investigation (Docket G-580), the Federal Power Commission announced on July 2 that, following the initial session at Kansas City, hearings would be held at Oklahoma City and New Orleans on Oct. 19 and Oct. 30, respectively. Later hearings will be held in Texas and other producing areas and then in consuming areas, with dates to be announced in the future.

FPC's topical outline—which the commission says is not exclusive and may be supplemented by other relevant material offered by interested parties and approved by the presiding officer—includes practices and problems as related to production of natural gas for interstate commerce, covering such matters as the functions of gas in connection with production of oil, and difficulties of adjusting gas and oil production to meet respective demands for each.

### State Laws Up for Review

State laws governing production, waste and conservation will also be considered, with special attention to such matters as the history of control statutes by the states, including results and limitations; recent developments and present situation as to state conservation legislation and its administration, in relation to such matters as gas-oil ratios; legislative history, activities, and accomplishments of the Interstate Oil Compact Commission.

Interstate pipelines will be spotlighted in another line of inquiry, which will cover development of long-distance transmission; significance of the large investment required, taking up such matters as the extent of need for a stable industrial market; sales and rate data of pipeline companies, showing distribution of total industrial sales by types of industrial customers, and relationships of industrial sales policies to financial condition of pipeline companies. Other issues to be covered in this connection will be effects on pipeline companies of restrictions on "export" and "import" of natural gas in interstate commerce, and the requisites of a sound public policy with respect to the expansion of interstate natural gas pipe lines in the postwar period.

### Utilization to Be Studied

Under the general heading of "utilization of natural gas," the commission announced it will cover the following topics:

"Policies regarding the use of natural gas, especially as related to: (1) present vs. future uses; (2) gas as a fuel and as an industrial raw material; (3) available and potential alternatives—their relative adequacy, location, quality, cost, price, etc.; (4) consideration of the fundamental importance of price in apportioning available supplies of gas and in determining competitive relationships.

"Utilization of natural gas by U. S. totals and states for 1937 and 1943 by classes and functions, showing: (1) Field uses—by types; (2) carbon black manufacture; (3) other uses as chemical raw material (rubber, plastics, etc.); (4) other marketed production for fuel purposes, showing separately (a) domestic, (b) commercial, (c) electric utilities, and (d) industrial, the latter segregated as to total, intrastate, interstate—total and "direct industrial" use in processes requiring close temperature control, as boiler fuel, and by other significant subdivisions.

"The question of controlling 'end uses' including: (1) history and objectives; (2) concepts of 'superior' and 'inferior' uses, as to (a) the technical aspects—efficiency of utilization of energy potential, and (b) the economic aspects dealing with comparative essentiality of use, availability of a feasible alternative, the extent to which price can be relied upon in prorating supply and providing an incentive to efficient use, the significance of incremental-cost prices and price disparities as affecting utilization of gas, the effect of rate policies on 'end uses' and other matters.

"Economic relationships of natural gas with competing fuels and raw materials, regarding: (1) evidence as to conflicting interests and views of gas, coal, railroad and labor and other groups; (2) the ex-

## Test Well Is Projected In Kentucky Cemetery

*Special to NPN*

HENDERSON, Ky.—Impending oil well development of a 58-acre tract of land which is part of Fairmount Cemetery has given the city of Henderson what is believed to be a rich stake in a potential oil field. Gulf Oil & Refining Co. plans drilling a test well on the tract this summer. The city owns the land but owns neither oil nor coal rights.

But in return for the privilege of right-of-way, the Ohio Valley Trust Co., Henderson, has agreed the city shall receive half of all income from oil royalties, bonuses and profits from future oil development, received by the bank as lessor. City Commissioners have approved of the arrangement subject to further legal steps.

Fairmount Cemetery is adjacent to an area known as the old Kleiderer coal and mineral properties, owned by the Ohio Valley Trust Co. Gulf has acquired leases on 2,750 acres beginning at the south city limits of Henderson, which embrace the cemetery and the Kleiderer lands.

# LIFE LINES
## to Dealers

**Car owners,** struggling to keep their present cars on the road, are anxious to buy new ones, of course.

But so are a lot of other people who have never owned cars.

Dealers haven't as good a contact with this group of new-car prospects as they have with car owners whose cars they have been servicing.

So car manufacturers have kept advertising right along . . . to create a favorable impression of the cars you will sell in the minds of people who have come into the market since the war.

• • •

**The wartime** job of selling these brand-new prospects has been entrusted, for the most part, to national magazines.

And LIFE, we are proud to say, has been privileged to assume a major share of this responsibility.

**When LIFE makes a discovery** and tells 22,000,000 people about it, exciting things happen.

Last fall, in an essay on the Colorado River, LIFE showed Riverman Norman Nevills (see above) at his favorite sport of shooting the river rapids.

Prompted by LIFE's account, Burton Holmes hired Nevills as his guide so he could do a lecture on the rapids. A movie company filmed Nevills's daring exploit. And the riverman got mountains of letters from interested future visitors.

"My future has been guaranteed through the LIFE story," wrote Riverman Nevills recently.

• • •

**LIFE is famous** for its travel stories. And when they can, people will be going places and seeing things again . . . prompted by LIFE's pointing out the way.

• • •

**Chock-full** of information of vital importance to all kinds of businesses is LIFE's booklet, "Reemployment of Veterans."

It tells of government plans, the work of various agencies, and the responsibility and position of U.S. employers.

We'll be glad to send you a copy if you'll write to LIFE Merchandising, 9 Rockefeller Plaza, New York 20, N. Y.

**Hangout for magicians** working in or passing through Chicago is Matt Schulien's café, on the North Side. Recently LIFE Cameraman George Karger, an able magician himself, dropped in at Matt's to picture an afternoon's legerdemain jam session. In this LIFE photo, Dr. Harlan Tarbell astonishes a couple of Matt's guests by proving that water need not run out of an upturned bottle, as he supports a tumbler in mid-air with the aid of a knife. This sprightly reporting is an example of the varied fare served up to LIFE's 22,000,000 readers week after week.

# LIFE has more readers every week than any other magazine . . .

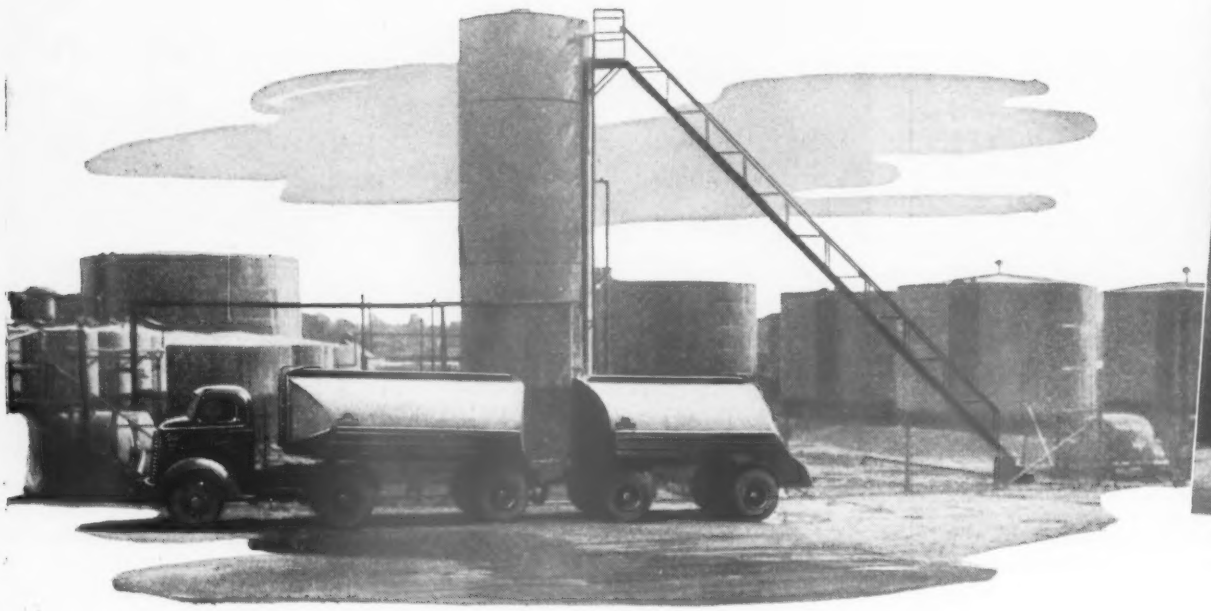
# LIFE sells your customers . . .

**They learn what's new in LIFE**

# FRUEHAUFS WORK TWO WAYS:

A FLEET of Fruehauf Tank-Trailers handles an outstanding hauling job for Taylor Transport Company of Bay City, Michigan. These Trailers deliver petroleum products for Bay Refining Corporation and bring back crude oil to the refinery.

In this two-way hauling operation, the Tank-Trailers leave the Bay Refinery anywhere from 4 a.m. to 7 a.m. each morning, depending upon the run for the day. They make deliveries as far as Cheboygan, Rogers City, Port Huron, Detroit and other cities within a radius of 200 miles.



ON the outbound trips the tanks are filled with gasoline, fuel oil and other petroleum products which go to wholesalers and to big industrial users such as Dow Chemical Company, of Midland, and Defoe Shipyards. At the latter they supply diesel fuel and oil for big vessels being built for Uncle Sam.

On return trips these Tank-Trailers supplement the pipelines which bring the crude from the major Michigan fields to the refinery, by hauling back additional crude from other scattered fields throughout the lower peninsula.

With this flexible Trailer method of hauling, Taylor is able to do an efficient job with 2-Trailer "trains", one with 6,550 gallon capacity, the other 8,275, and 5 Semi-Trailers with capacities of from 3,150 to 4,200 gallons.

They work the year around, in all kinds of weather, with capacity loads every day of the year, and it is this ability to render service hour by hour, day by day and year by year, without faltering, that has led to Taylor's choice of Fruehaufs.

**FRUEHAUF TRAILER COMPANY • DETROIT 32**

*World's Largest Builders of Truck-Trailers* *Service in Principal Cities*

"Engineered Transportation"

REG. U. S. PAT. OFF

# Distribute Petroleum Products... Supplement Pipeline!

## Opportunity for Ex-Servicemen . . .

A number of openings are available in Fruehauf Factory Branch Service Stations for men with mechanical ability. These positions offer excellent training and opportunity to graduate to the company's sales force. Contact your nearest Factory Branch for further information.

# Fruehauf Trailers

tent, character, and results of the competition between fuels, showing (a) extent of competitive range, (b) specific data on the effect of natural-gas usage on the consumption of coal, employment in the coal industry, and transportation of coal—especially for industrial purposes in areas where reserves of coal of desired grade are abundant; and (c) significance of probable price trends for coal in relation to future utilization of natural gas; (3) relative availability of coals, oil and water power by areas; (4) importance of quality differences; (5) consideration of the possible emergence of new price-cost relationships over a broad range of the national economy relating to fuels and raw materials; and (6) relationships of natural gas to the manufactured-gas industry, showing (a) data on displacement of manufactured gas; (b) comparative costs—present and prospective; (c) manufactured-gas facilities as standby; and (d) mixed gas, including data as to extent, places and reasons, and mixing as a device to preserve investment in manufactured-gas facilities, to promote improved technology in manufactured-gas production, to utilize by-product gases of industrial processes, and to conserve remaining supplies of natural gas.

**Broad Objectives Set**

This investigation differs from the formal hearings which FPC ordinarily conducts, the commission noted, because it is "intended to develop information for the use of the congress, the commission, and the public generally."

In the back of the commission's collective mind, as it proceeds with the investigation, are charges from coal people that natural gas used for "inferior purposes"—such as in heating of industrial boilers—threatens the jobs of miners; complaints of some state conservation commission that gas companies exporting gas from individual states are depriving those states of a vital natural resource; and charges from some quarters that "undue waste of gas"—through flaring and "inferior use"—may imperil national defense.

Four "basic objectives" which WPC says will guide the investigation from start to finish are: "(1) to furnish all interested persons with an opportunity to present their views with a minimum expenditure of time and money; (2) to secure as much information as is possible on all matters relative to the investigation; (3) to have all such information presented in the record as expeditiously as possible; (4) to provide opportunity in the hearings for testing the validity of the information which is presented."

Each witness desiring to testify is advised to notify FPC either orally or in writing, at least 15 days in advance of the hearing at which he desires to appear. In addition, those presenting exhibits are asked to prepare at least 100 copies for distribution to State commissions and other interested parties.

Heading the commission's investigation as chief counsel is George Slaff. Those working with him as consultants or staff members include the following: David Cohn, FPC research assistant; James V. O'Connor, FPC gas engineer; Robert Hunter of the Ohio State University law school, special assistant to the Department of Justice on anti-trust matters; Alec Crowell, director of the Mississippi Oil and Gas committee, and former state conservation director of Arkansas; Roy A. Wehe, assistant director of the division of Public Utilities, California Railroad Commission; Prof. Edwin A. O'Rourke, Ohio's representative on the Interstate Oil Compact Commission, and professor emeritus of chemical engineering at Ohio State University, as well as a consultant to Shell and other companies; Prof. Alfred H. White of University of Michigan, professor emeritus of chemical engineering and a member of the board of Michigan Consolidated Gas Co., a specialist on gasification of coal.

## Stanolind Oil & Gas Spends $5,400,000 in East Texas

*Special to NPN*

DALLAS, Tex.—Stanolind Oil & Gas Co., adding to its domestic production holdings, has purchased 72 oil wells and 350 acres of leases in the East Texas field for approximately $5,400,000, or an average of $75,000 per well.

The sale was made by Wheelock & Collins of Corsicana and associates, and reflects continued interest in the great East Texas field. The sale was the largest reported so far this year.

Although a breakdown of the properties involved in the sale is not available, it is reported the deal includes both "fairway" and edge properties.

Stanolind is a producing subsidiary of Standard Oil of Indiana. Since Standard of Indiana a few years ago sold its foreign properties, it has been accumulating large production acreage in both east and west Texas.

## Bureau of Mines Forecasts All-Time Crude Records

NPN News Bureau

WASHINGTON — Predicting that production and demand for crude will "exceed all previous records" during the second quarter, the Bureau of Mines this week also said that average production of 4,861,300 b/d would be needed to meet demand in July—a gain of 125,000 b/d or 3% over the same month of 1944.

The agency noted that data available for May and June indicate that crude production has already increased substantially and that average demand is approaching 4,900,000 b/d resulting from record production of 4,801,000 b/d and a stock increase of 8,000 b/d.

During the first four months of this year, crude production averaged 4,777,000 b/d, up 355,000 b/d or 8% from the same period in 1944. Demand for domestic crude from January through April, 1945, amounted to 4,753,000 b/d, an increase of 257,000 b/d or 6%. During the first quarter of 1945, 24,000 b/d were added to stocks of domestic crude, compared with withdrawals from storage of 74,000 b/d in the first quarter of 1944.

Foreign and domestic crude runs to stills averaged 4,746,000 b/d during the first four months of 1945 and were 363,000 b/d or 8%, higher than in the same period of 1944. The Bureau added that current data for May and June indicate a further gain in runs to about 4,870,000 b/d.

## Indiana Men Seek Manufacture Of Synthetic Liquid Fuels

*Special to NPN*

EVANSVILLE, Ind. — Business leaders of this Southern Indiana area possessing both strip-mine and deep-vein coal production are seeking to induce the United States Bureau of Mines to establish one of four proposed experimental plants and laboratories for the manufacture of synthetic liquid fuel from coal, in or near Evansville. Representative Charles M. LaFollette of the Eighth Indiana District is working with the Evansville Chamber of Commerce with hopes of landing the project. It would be constructed and put into operation after the war.

Originally it was announced that only two experimental laboratory plants for the conversion of coal into gasoline were planned, each to be constructed in the heart of the coal belt.

After the visit to Evansville late in 1944 of L. L. Newman and J. C. Curoe, both of the Bureau of Mines, Washington, it was said that four such experimental plants are likely and that the Pocket Hoosier area, served by a network of railroads from the coal mines of Northwestern Kentucky, Southern Illinois and by the Chicago & Eastern Illinois Railway and the New York Central in the nearby Indiana fields, gave Evansville unique advantages for such a plan.

Officials of the Bureau of Mines explained that an acceptable site must be at least 40 acres in size, and with water, sewage, natural gas and electric power facilities to accommodate a plant which will employ perhaps 200 persons.

Extensive mechanical installation will be necessary for the experimental work in producing gasoline from coal, and considerable quantities of coal from every producing field within a 75-mile radius of Evansville would be employed in the experimental research.

Sites in other coal producing areas have been inspected preliminary to final decisions. Arthur P. Eberlin, secretary-manager and Leslie LeCroix, traffic manager and research director of the Evansville Chamber of Commerce, said presence of vast coal fields at the front door of Indiana's biggest producing oil pools possessed features of advantage in the Bureau of Mines engineers' opinions.

# Additives that are right for Compounders and Refiners who want to improve their lubricants

**PARANOX** — *Inhibitors and "HD" Additives*

**PARATONE** — *For Higher Viscosity Index*

**PARAFLOW** — *For Lower Pour Points*

**PARATAC** — *For Tacky Oils and Greases*

**PARAPOID** — *For "EP" Gear Oils*

*Into these products are built the know-how and experience in making better oils because they are developed, manufactured and proven in use by the largest petroleum research laboratories and affiliated oil companies.*

**WE RECOMMEND PARANOX 105** for improving truck, bus and farm oils. It controls oxidation and bearing corrosion—promotes cleaner, more efficient engines—better oil performance under severe operating conditions.

**PARAFLOW SALES DIVISION, Chemical Products Department, Stanco Distributors, Inc., 26 Broadway, New York 4, N. Y. Tulsa District Office: c/o Carter Oil Company, P.O. Box 801, Tulsa, Oklahoma. Chicago District Office: 75 E. Wacker Drive, Chicago 1, Illinois**

## PAW Skeptical of Gain From Borneo's Oil

NPN News Bureau

WASHINGTON—Importance of the recovery of the Borneo oil fields was minimized by PAW in a statement this week which pointed out that even if production can be restored to prewar levels the fields would yield only 55,000 b/d out of a total United Nations production of 7,000,000 bbls.

As it is, PAW added, all calculations as to the possible usefulness of Borneo crude in fighting the Japanese war must take into account the possibility that production may never reach prewar volumes. The Japs, PAW said, have operated the wells intensively during their occupation "and may have so depleted them that further drilling may not be worth while. Moreover, many of the wells have been reported burning for the last two or three weeks."

Requirements for equipment necessary to rehabilitate the Borneo fields already have been anticipated, Deputy PAW Davies said, but a survey to determine the extent of Japanese demolition will be necessary before the supplies are shipped to minimize demands on overloaded Pacific shipping.

### Tarakan Easy to Restore

Some fields, notably those on the island of Tarakan, might be put into production in a relatively short time despite demolition by the Japanese, but others may require from a year to two years before prewar levels can be reached, he added.

Capture of the island of Tarakan, off the northeast coast of Borneo, will give our forces possession of wells that produced about 15,000 b/d in 1940. These wells were destroyed before the Japanese occupation in 1942, but were believed to have been brought back to a daily production of perhaps 8,000 barrels when they were taken earlier this month by Australian forces. The oil from these wells needs only to be separated from the water found with it to be used under a ship's boiler without further refining.

The Seria Field in Brunei, accounting for about 17,000 b/d and the Miri field (also known as Lutong) in Sarawak, with about 3.000 b/d, both in northwest Borneo, produced about 35 per cent of the Borneo total in 1940.

Contrary to published reports, oil from these fields requires refining before it can be used, although relatively simple equipment is required, Mr. Davies said.

The Samarinda fields, yielding somewhat more than one-third of the island's production, are in the southeast portion of the island still is possession of the Japanese forces.

While production in the Tarakan field had not been brought back by the Japanese to the prewar level, they are believed to have done better with the Brunei fields, which were reported to be yielding more than twice their prewar tonnage in 1944.

The most important advantage resulting from retaking of these fields comes from their proximity to the scene of operations against the Japanese homeland.

A 10,000-ton tanker carrying 65,000 barrels of oil from a Gulf of Mexico port to Okinawa, for example, takes about 90 days for the round trip, while one making the trip from the West Coast takes about 50 days. The same tanker could make the trip from Borneo to Okinawa in about 12 days and from Borneo to Manila in about six days.

The same advantages will accrue from recovery of other fields in the Netherlands East Indies, which besides Borneo, includes Java, Dutch New Guinea and Sumatra, the latter island being the largest producing area of the entire group, PAW said.

Total production of the Netherlands Indies in 1941 was approximately 170,000 b/d, of which Sumatra produced more than half. In the three years of their occupation, the Japanese are believed to have restored daily production to about 140,000 barrels, representing perhaps 90 per cent or more of Japan's total oil resources.

The Burma fields, now lost to the Japanese, produced about 21,000 b/d in 1941, but were cut down to less than 3,000 b/d in 1944 by the Eastern Air Command.

## Dallas News Raps Drew Pearson on Tidewater Land

*Special to NPN*

DALLAS, Tex.—The *Dallas News*, influential Southwest newspaper, has taken sharp issue with Drew Pearson over the columnist's recent views on the effort of the federal government to take over state tidewater lands. The *News* carries the Pearson column as a regular feature.

The editorial follows:

"The columnist who writes a thousand or more words a day can be expected to get out on thin ice once in a while. Drew Pearson did so in his article in The News on the subject of the submerged oil lands.

"The 'marble halls' of Congress, he wrote, are thronged with lobbyists 'whose goal is oil', though 'their aims are much more lofty—namely, the quieting of titles of states to lands beneath tidewaters and navigable waters'. Mr. Pearson says that the oil companies want the land to be leased by the states because the 'statehouse boys' can be handled more easily than the Federal Department of the Interior. Is that so? Did the statehouse boys or the Department of the Interior handle the Teapot Dome deal or any one of the several other oil leases that have stood out above all other scandals in our natural history during the past few decades? Of course, Mr. Ickes was not head of the department at that time but Mr. Ickes is a transient factor in the Department of the Interior. It is the institution and not the man that must be considered in the adoption of any such policy.

### Recalls Teapot Dome

"But this is not the worst of Mr. Pearson's errors. He states that the fight has been waged 'to keep these oil lands in federal hands.' They have not been in federal hands. All leases have been made by states. That is the primary reason why certain oil industries are represented in Washington. It is not that they think they can handle the 'statehouse boys' easier than they can the Department of the Interior. It is simply that they already have their leases and don't want to go through the adjustment that would be necessary if the title changed in the federal government. Any individual, or any corporation or the government itself would do the same thing under similar circumstances.

### Affirms Texas' Rights

"Mr. Pearson makes no distinction between the Gulf tidal lands (obviously referring to Texas) and those of the Pacific. Texas has a written agreement with the United States for the retention of the title to its public domain. The greatest issue involved (in Texas, certainly) is whether title to our public school and university lands and the magnificent endowments derived therefrom be jeopardized. The columnist says that 'the prosperity of the national treasury' is on the side of federal acquisition of the lands. The prosperity of Jesse James was always on the side of his ability to handle successfully the boys in the mail and express cars.

"In this matter Mr. Pearson, like a good many others, has become completely saturated with the Washington atmosphere and completely converted to the Washington viewpoint. Anything that is against the federal government's acquisition of greater power is downright immoral. They ought to get out in the country once in a while and get the viewpoint of the people first hand. If Mr. Pearson would do so he might see in the present move of the federal government an attempt to hijack the states (and especially Texas with its unique claim to its public domain) of their rightful possessions. It isn't a coincidence that the national government became interested in these lands after oil was discovered on them."

(Texas Land Commissioner Bascom Giles recently recalled that when Texas joined the Union the state offered the federal government title to all the public domain if the United States would pay off the state debt of $15,000,000. The government refused to accept the deal on the grounds that the land was worthless.)

# Available NOW!

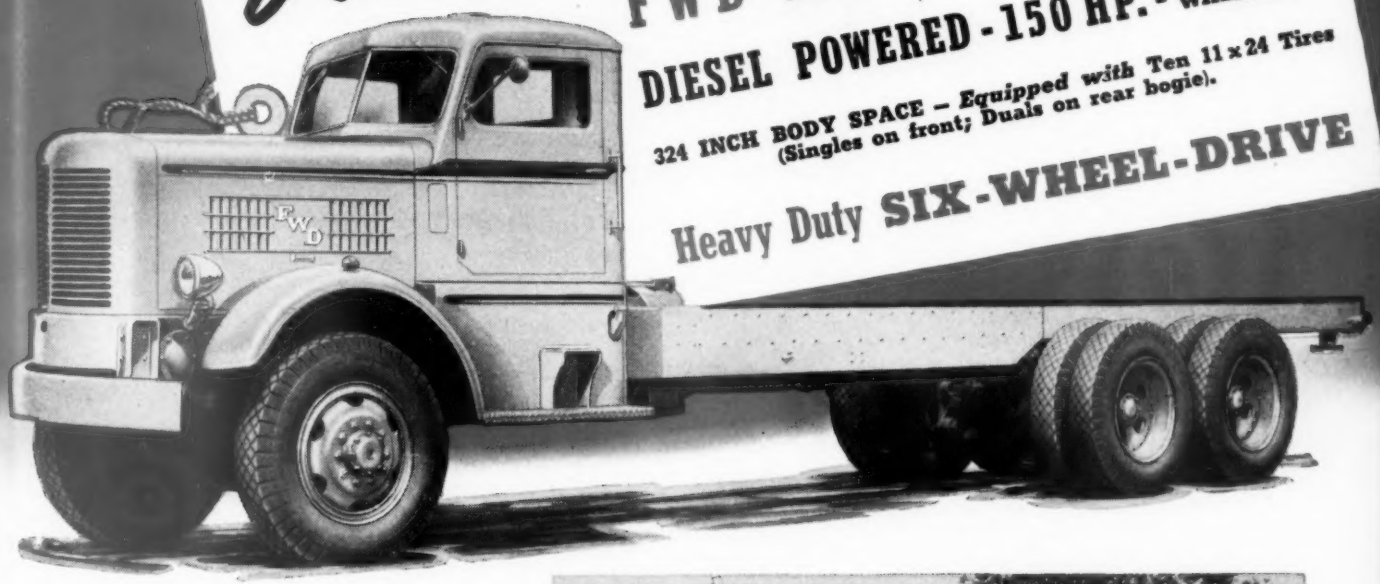
## FWD Model M6x6

*Limited Number*

**DIESEL POWERED - 150 HP. - 276 INCH WHEELBASE**

**324 INCH BODY SPACE — *Equipped with* Ten 11 x 24 Tires (Singles on front; Duals on rear bogie).**

**Heavy Duty SIX-WHEEL-DRIVE**

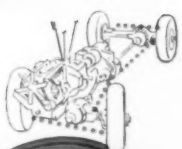


One of the most popular "six-by-six" heavy duty trucks in oil field service, is the FWD Model M6x6. All have a great record in the toughest of service. In limited numbers these powerful trucks are authorized by PAW for oil-field use, and are ready for immediate delivery to users who can qualify for release from ODT with PAW approval. Your FWD Distributor will gladly cooperate with full details.

## Available IN THE NEAR FUTURE...

A limited number of FWD four-wheel-drive trucks, in capacities from 2 to 10 tons, also will be available in the near future.

Since all these trucks are subject to prior sale it is important that you act promptly to avail yourself of these opportunities.



FWD TRUCKS

THE ORIGINAL EXCLUSIVE BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS

*See Your* **FWD** *distributor* **AT ONCE!**

**THE FOUR WHEEL DRIVE AUTO CO.**

**Clintonville, Wisconsin**

**CANADIAN FACTORY: KITCHENER, ONTARIO**

## Tanker Surcharges Cut 10% by WSA Order

NPN News Bureau

WASHINGTON—A reduction of 10% in tanker freight rate surcharges on movement of bulk liquid cargoes over various Western Hemisphere routes was announced by the War Shipping Administration this week.

A uniform and considerably reduced surcharge of 10% was ordered on basic freight rates on bulk petroleum and products moving to and between ports outside the continental United States, eliminating many individual and widely variant surcharges heretofore in effect.

Surcharges also are reduced to the 10% level in the case of many other bulk liquid cargoes, such as creosote and benzol, while certain changes are made in basic freight rates for the South American trades and a new scale of small tanker rates has been fixed for operations to the Windward and Leeward Island, British Guiana, and Netherlands Guiana.

All changes are effective on tanker cargoes whose loading is completed on or after July 1, 1945.

### Increased Economies Predicted

NPN News Bureau

DETROIT — Tremendous economies in the delivery of petroleum products during the postwar period are predicted by Lew Thomas, manager of the Tank-Trailer Division of Fruehauf Trailer Co.

"Because of the need for expediting gasoline, fuel oils, tractor fuels and other petroleum products during the war, the development not only of tank-trailers for the purpose but also of straight line delivery methods, will result in benefits to consumers after the war is over.

"A large demand has developed for the 5400-gallon tandem tank-trailer through the midwest area," Mr. Thomas said.

## Smooths Path for Vets As Tire Dealers

NPN News Bureau

WASHINGTON—Returning veterans this week got the green light from OPA to become tire dealers on a small scale, if they so desire.

While only small tire stocks can be purchased on the certificates OPA will make available—10 passenger tires, 4 small and 2 large truck tires, and 6 tractor-implement tires—the agency said such a supply "will be a valuable adjunct to the veteran entering an allied automotive business such as the sale of gasoline, the maintenance of a garage, or the recapping and repairing of tires." Sale of the small tire stock alone, OPA noted, would not provide satisfactory income.

### May Replenish Stocks

OPA said that under the new plan a veteran may replenish his stock by sending his certificates to his supplier for replacements, and that during his first year as a dealer he may dispose of his dealer inventory by returning it to his supplier or by transferring it to another veteran. Either method must be approved by an OPA district office.

OPA's action was taken in Amendment 100 to Ration Order 1A—Tires, Tubes, Recapping and Camelback — effective July 6.

Further aid to returning veterans meanwhile was promised by War Production Board in the form of relaxation of limitation and materials conservation (L and M) orders, to make production materials available to small users, including newcomers, on a wide scale. Exception to this rule—embodied in WPB's General Program Order No. 517—is the case of certain materials whose supply must be restricted because of the war.

## Texaco Wins Ohio Safety Awards

**These Texaco sales executives in addition to being "quota busters," also break other records. In the picture above they are displaying three plaques awarded the Ohio organization of the Indianapolis division for the lowest average of accidents per employe in the State of Ohio for the year 1944. These plaques are annual awards given by Socony-Vacuum, the State of Ohio, and the Ohio Oil Co. Every oil company in the state of Ohio is eligible to compete. Above, front row, left to right, are Dixon Guy, Texaco division manager, Indianapolis district; W. W. Burton, distributor representative; R. W. E. Meyerholtz, Canton representative; J. A. Rattan, Columbus representative. Rear row, left to right, B. S. Moore, Cincinnati representative; J. A. Winger, assistant division manager, Indianapolis district; F. J. Novak, Ohio state manager; B. D. Harris, resale salesman, Dayton; and M. H. J. Knoll, Lima representative**

## Firestone Experiments On Tire To Last Life Time Of Car

*Special to NPN*

AKRON, O.—John W. Thomas, chairman and directing head of the Firestone Tire & Rubber Co. announced that company rubber researchers and engineers have under development tires that may wear as long as the automobile they are used on, and are proof against punctures or skidding.

Though some of these developments are still in the formative stage and accurate estimates cannot be made as to how long it will be before such tires are on the market, Mr. Thomas said that there is little question that through the limitless capacities of research these objectives may be achieved.

"A tire that would run 3500 miles was the goal of the rubber industry several decades ago," Mr. Thomas declared, "but now it is unusual for passenger car tires to run ten times that far and it is no trade secret that we ultimately expect to produce a tire that will run 100,000 miles."

# How a Piece of STEEL and a Little TIN Protect Your Oil from TAMPERING!

• Drop for drop, your oil must be protected against substitution. Only in that way will users have confidence and brand preference *for your oil.*

When oil is packaged in cans, tampering is impossible. So, in the sturdy steel-and-tin can . . . which is more than 98% steel, less than 2% tin . . . you can give motorists the oil they want . . . full measure . . . clean, dependable oil.

Yes . . . steel and tin, made into cans, protect your oil, satisfy your service station operators and please the motoring public. Plan *now* to package your oil in *cans* when cans become available again!

**SELLING THE CAN IDEA TO EVERYBODY!**

Look for big full-page, full-color ads currently telling shoppers everywhere how convenient *cans* bring them their favorite products with full quality *sealed in!* More than 26,000,000 printed messages appear this month, in five national magazines and in the magazine sections of Sunday newspapers from coast to coast.

**CAN MANUFACTURERS' INSTITUTE, INC., NEW YORK**

***And that's not all!***

***Steel-and-tin cans bring you these added advantages:***

1. They don't break, split, tear.
2. Require no special packing or handling.
3. Cans are light, compact . . . economical to ship, save shelf and storage space.
4. Stay neat and clean.
5. Labels can be lithographed on cans.

NO OTHER CONTAINER PROTECTS LIKE THE CAN

# P.I.W.C. Economics Group, in Denver, Sizes Up War Needs

**Members of the subcommittee on petroleum economics of the P.I.W.C. at meeting in Denver last month. Seated (left to right) R. J. Gonzalez, Humble Oil Co.; J. M. Sands, Phillips Petroleum Co.; Fred Van Covern, Chairman A.P.I.; J. W. Boatwright, Standard Oil Co. (Ind.); J. A. McIntosh, Socony-Vacuum Oil Co.; C. M. Lake, Shell Oil Co.; M. E. Tracey, Richfield Oil Corp.; J. H. Ellender, PAW. Standing (left to right) Robert Evans, Secy. Gen. Com., Dist. 4; George L. Bonar, The Texas Co.; J. P. Coleman, McCarty & Coleman; Fred Eisele, PAW; A. T. Bartlett, Shell Oil Co.; J. A. Lentz, Continental Oil Co.; E. T. Knight, Atlantic Refining Co.; F. R. Marshall, Ref. Section, Ind. Com. Dist. 5; H. A. Lapham, Union Oil Co.; Oliver S. Ambrose, Tide Water Associated Oil Co.; Lynn Wolfe, Phillips Petroleum Co.; R. C. Steves, Standard Oil Co. (Calif.); Lt. (j.g.) R. N. Sears, PAW.**

*Special to NPN*

DENVER — The subcommittee on petroleum economics of the P.I.W.C. met here for a five day meeting which started June 18, to plan how best to produce and transport the petroleum products necessary to the war in the Pacific and to supply other essential demands. This is the fourth time the committee has selected Denver for its sessions.

Attending were 25 production chiefs, refinery experts, economists, transportation men and members of the PAW, comprising the working subcommittee of the petroleum economics committee of the P.I.W.C.

The committee's report will be reviewed by the economics committee in Washington on July 17, and if favorably received will be submitted to P.I.W.C. on July 18.

Members from the various sections of PAW attended all sessions, furnished the latest military estimates of requirements for various products, and supplied the latest information concerning the availability of transportation to get the products to the points where needed.

The committee voted to hold its next meeting in Chicago early in October, but is ready to meet sooner should a change in the war situation make it advisable.

J. A. Lentz, member of the subcommittee, sales manager of Continental Oil Co. and representative of Dist. 4, acted as host. He arranged a brief tour of the city and a mountain trout dinner. Because of the press of work, Mr. Lentz said, no time was found for golf and other entertainment usually associated with a meeting of this kind.

## Country Schools Will Benefit By Highway Improvements

NPN News Bureau

WASHINGTON—At a conference of educators here, Charles M. Upham, engineer-director of the American Road Builders' Assn., said that rural education would receive a great impetus from the postwar highway construction program. Improvement of secondary or country roads under the Federal-Aid Highway Act of 1944 will make consolidations of thousands of school districts possible and thus raise educational standards for farm children, he explained.

The engineer-director pointed out that a study made by his association in a number of representative counties showed that nearly 70% of the country schools are still on dirt roads. "Highways are the bottleneck to the growth and expansion of the consolidated school," Mr. Upham said, "but under the postwar program more than $300,000,000 will go for farm-to-market roads. This is a good start toward pulling our country schools out of the mud."

"America has 2,400,000 miles of rural roads serving 6,000,000 farms, but only 45,000 miles have a high-type pavement and 99,000 miles have a low-type bituminous surfacing," Mr. Upham continued. "The other 2,262,000 miles of country highways have a non-treated surface, are merely graded and drained, or are simply trails. When we consider the millions of farm children that must use such roads, the need for giving attention to our highways strictly from an educational angle becomes apparent."

## Mexicans Order Bulk Station

*Special to NPN*

BROWNSVILLE, Tex. — Petroleos Mexicanoes, the Mexican government-controlled oil company, has let a $150,000 contract for construction of a bulk station at the port of Brownsville, according to port authorities.

Contractors will be Dodds & Wedegartner of San Benito, Texas. The company will use the plant to store products for distribution to points in northern Mexico from Matamoros to Juarez.

# There's PROFIT
## IN THE DIAMOND D-X FRANCHISE

DIAMOND D-X

*Lubricants - Fuels*

The days of competitive selling are ahead. Are you ready . . . with a complete line of top quality petroleum products . . . a line with many exclusive features that make customers and hold them?

The Diamond D-X Franchise provides these advantages, and the Diamond D-X line will be expanded with new war-born developments as soon as victory gives the "green light."

**Plan Now for Post War Sales**

For protected sales territory investigate the D-X Franchise today. Why not join the hundreds of Diamond D-X Distributors throughout the central states who have been successful with the Diamond D-X line and the B. N. B. plan for profits? ACT NOW while territories are open. Tomorrow may be too late.

D-X MOTOR FUEL

**MID-CONTINENT PETROLEUM CORPORATION**

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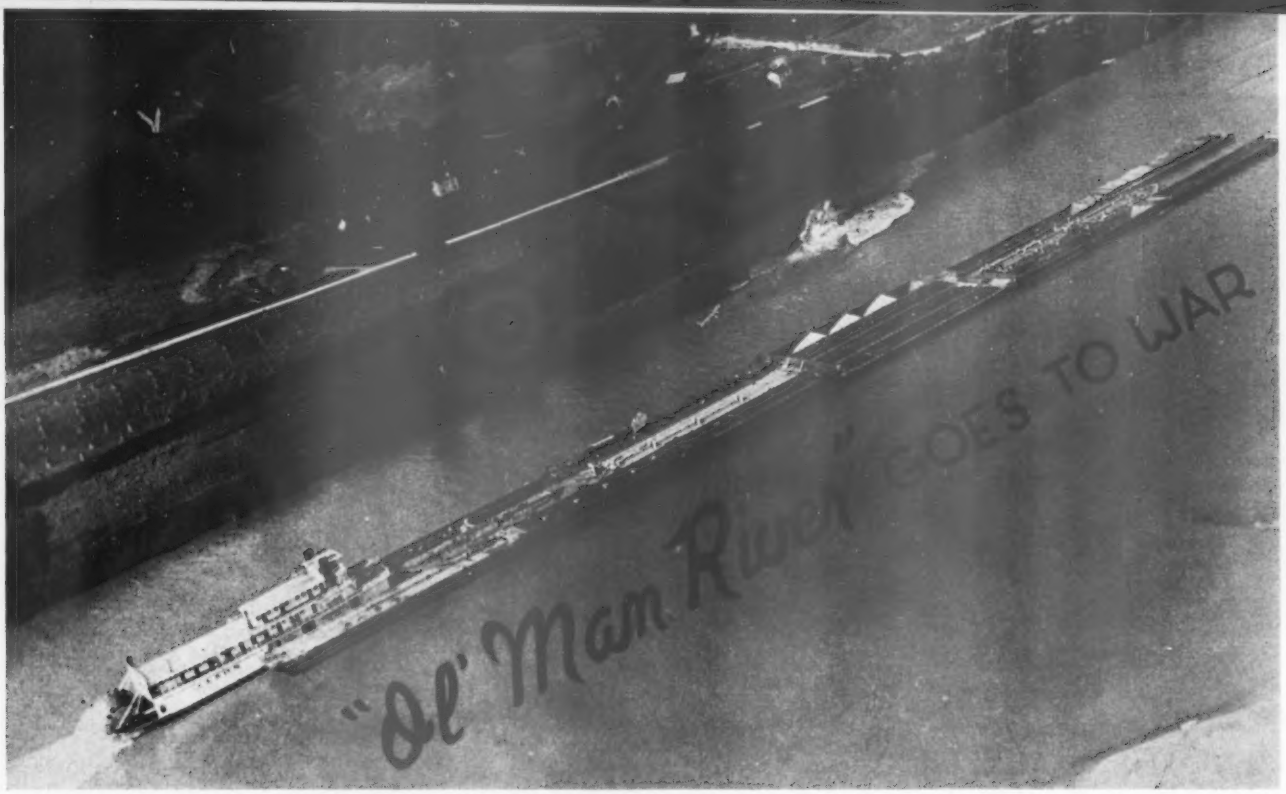
DIAMOND 760 MOTOR OIL

*In addition to the famous Diamond D-X Petroleum Products, Mid-Continent offers a complete line of unbranded and industrial lubricants.*




# Nation's New-Built River Fleets of Oil Towboats Make Records in Transport Required for Victory

*By David I. Day*

Our nation should never forget the oil transportation crisis it faced the early months of 1942. We were at war. Submarines prowled the Caribbean and the Atlantic seacoast. The problem was how to meet the oil needs, military and civilian, of the teeming Middle Atlantic and New England states. It presented a situation so serious as to grip the attention of the entire country.

We had one advantage. During War 1, the little Monongahela alone among the rivers had been of much service in relieving the transportation bottleneck. It taught a lesson. Between the two wars, billions of dollars had been spent on locks and dams to provide an all-year 9-foot stage of water on the upper Mississippi, the Ohio, the Tennessee, and the Illinois Rivers. All we required after Pearl Harbor was the building of enough boats and barges and the training of sufficient men to make full war-time use of these canalized inland waterways.

### Many Yards Build Ships

While this was done, pipelines were started to connect with river boats and with railways. All in all, it was a construction program so vast and varied as to stagger the imagination. Shipyards were geared up to the highest possible production. New shipyards were opened. It seemed a long time then but, looking back, it is remarkable in how short a time a parade of brand-new all-steel towboats were completed and set to work pushing oil and gasoline up the waterways.

At Houston, Tex., 1300 hp "Edgar C. Johnston", now the "Sohio Memphis", was built promptly and came up the Mississippi from Texas with a sizeable cargo. On the Missouri River at Blair, Neb., the Petersen-Lytle shipyards completed the motor vessels "Henry C. Ogram" and the "Margaret Dawson" now operated on the upper Ohio by the Ashland Oil & Refining Co. The "Celeste" came off the ways on schedule at the St. Louis shipyards and went to work for the Taylor Refining Co. From the same yards in due time came the giant "Sohioan" the most powerful Diesel towboat on any river, 2415 hp. Ohio Standard also increased its river oil fleet by the purchase of the steamers, "Atlas" and "Renown" which had been in use in Louisiana as railway transfer steamers. It bought also the "Ellen" which had previously been a U. S. Engineers towboat. All were shortly bringing up tows regularly.

Out came the Pure Oil Company with the fine motor vessel, the "Chas. W. Snider" at the Sturgeon Bay shipyards, a boat that proceeded to make a string of towing records. The Ashland Oil & Refining Co., began an amazing expansion program which eventuated into a fleet of seven Diesel vessels, not including chartered boats, the most powerful being the "Paul Blazer", the "Ashland", the "Tri-State" and the "Jim Martin."

In due season, day and night, the rivers were almost crowded in places by boats of all sorts and types. Within a few days at the mouth of the Ohio River, one might see the towboats of the Mid-Continental Barge Co., the Lake Tankers Corporation, the Midwest Towing Co., the Patton-Tully boats from Memphis, the Hougland boats from Paducah, the boats of Indiana Standard the Jersey Standard, and scores more.

Everywhere, particularly in the industrial East, the cry was heard for "more boats, more barges, more oil." The war was pinching, the people were impatient. They were inclined to disregard costs, to demand results. From coast to coast, the clamor was for action.

So the Government through the Defense Plant Corporation announced in the summer of 1942 the approaching construction of 21 huge 2000 hp steamboats, 100 diesel tugs of 600 hp, and their necessary barges. The contracts were let for the steamers to six leading river shipyards. Work proceeded promptly on the tugs and the barges. When the news filtered around the river ports that these mammoth steam towboats were to cost $1,000,000 each, there was no word of complaint. Indeed, the response everywhere was: "When Hitler hears of this!"

### Named for Battlefields

Newspapers on and off the rivers told of this, "Emergency Oil Fleet" to be built and chartered to responsible oil towing concerns. The boats were to be identical, 180 feet long, 52 feet in beam. 11 feet molded depth. It has been originally planned to power them with Diesel engines but these were not available and time was too precious to wait. The boats were all to be named for places where our fighting men had won glory in the South Pacific. And today plow the rivers these great white boats

*Reo tractor with 5000 gallon tank trailer*

**Reo trucks and tractors are designed and built to provide the capacity, power and speed needed for a great variety of hauling jobs in the petroleum industry. They are precision-built to assure a high degree of profitable, trouble-free service.**

**Reo produces powerful vehicles for the Armed Forces—from medium-duty supply trucks to huge 10-wheel tractors for airplane refueling units. They have measured up to the most exacting military standards—they've proved on world battle fronts they have what it takes!**

**Limited quotas of brand-new 1945 Reos are being released for essential civilian service. If your needs are critical, ask your Reo dealer for complete information.**

**REO MOTORS, INC., LANSING 20, MICHIGAN**

*Factory Branches, Distributors and Dealers in Principal Cities*

*BUY MORE WAR BONDS*

# REO

**1904 • AMERICA'S TOUGHEST TRUCK • 1945**

**REO GREW UP WITH GASOLINE**

bearing names like "Corregidor", the "Attu", the "Wake Island" and the "Coral Sea." The first of the big steamers was launched in August, 1943 and in late 1944, they were all in active service.

The DPC tugs were not named but numbered from 1 to 100, all identical, all powered with General Electric motors. It seems to have been the original idea to use them only on the Gulf Intracoastal Canal and the Atlantic Intercoastal Waterway but several of them have been at work the length of the rivers.

Notable among the new boats of 1943 was the "Jean Marie" of the Lea River Lines. She was built at the Blair, Neb., yards, 108 by 30 feet in dimensions, a triple-screw vessel rated at 1050 hp. At the yards of the Nashville Bridge Co., Nashville, Tenn., were biult two boats which have rendered excellent service since. One was the "Emory T" of Clark's Super Gas Co., Milwaukee. She is 102 feet long by 23 feet wide, powered with an 810 hp Diesel engine. Of virtually the same size and power is the "Harry Simpson, Jr.," of the Simpson Towing Co., Charleston, Mo. At old Paducah was launched the serviceable triple-screw "Willie Mayo" with 1200 hp to work for the Roberts Towing Co.

Down at Greenville, Miss., the Greenville Towing Co., with two boats already in the oil trade brought out the new 520 hp "Ruth Brent" while the Charles C. Smith Company of Houston built new tug boats which soon left their native habitat to bring oil up the rivers. The Pure Oil Co., remodeled the good towboat "R. H. McElroy, Jr.," to make her usable in shallower water. The noted old U. S. Engineer boat, the "C. B. Reese", was most completely modernized into the steamer "Wood River" and is now making a name for herself in behalf of her owners, the Wood River Oil Co., as an upper Mississippi oil pusher.

### Mount Vernon—Oil Port

Since the war started, the Federal Barge Line boats, including the famous 2200 hp "Herbert Hoover", have handled many millions of gallons of gasoline and oil on all the principal rivers. The "Ivan Harris" of the Indiana Farm Bureau, Mt. Vernon, Ind., a delightful diesel sternwheeler, serves the co-operative's refinery over hundreds of miles of river. Speaking of Mt. Vernon, now headquarters for Sohio boats, we are reminded of how it has sprung into prominence the last three years as an oil port and the center of an oil field. The Maxon Construction Co., Tell City, Ind., made Mt. Vernon famous for barges. In truth, everywhere and along all lines, the waterways in 1943 witnessed swelling freight volume, traffic widening into new fields, and with this came a veritable flood of newspaper and magazine publicity until the movie magnates discovered the romance of the rivers.

Before the last of the great DPC steamers came off the ways, to go to work for Standard Oil of Ohio, her earlier sisters had established many of the most remarkable river towing records extant. All the DPC tugs were working. A number of towboats ordinarily in other trades were engaged in the oil business. Millions of gallons of gasoline, crude oil, and fuel oil were brought up from the South in mixed tows.

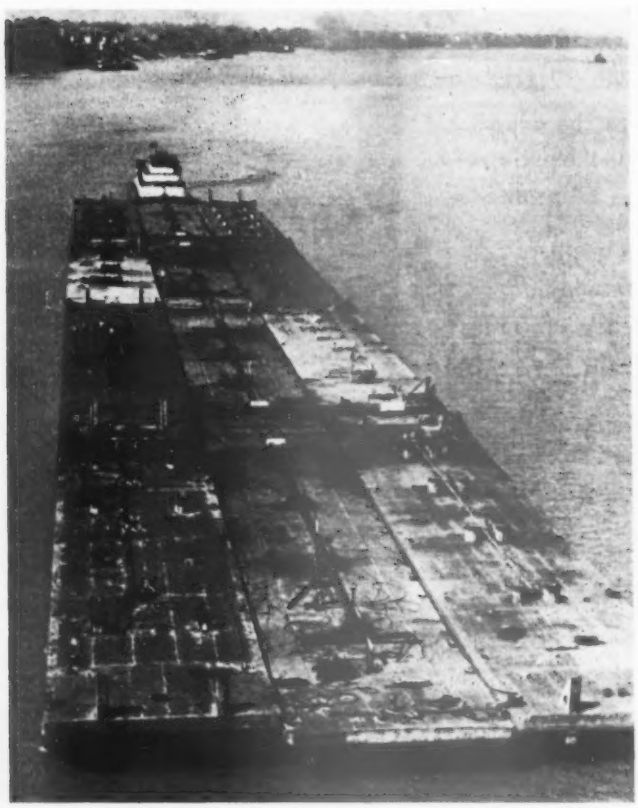
An event of widespread interest in 1944 was the completion of the Diesel vessel "Minneapolis Husky" which is the largest single-screw boat on any inland river. Owned by the Upper Mississippi Towing Corporation built at the Blair, Neb., shipyards, measuring 118 feet long by 30 feet wide, powered by a big 1400 hp engine, her career has been watched with intense interest. Since her launching, she has been given a larger propeller and somewhat remodeled to make more complete use of her power. She has moved millions of gallons of oil. The remodeling of the "Republic-Pittsburgh", the rivers' only tanker, at the Hillman yards near Brownsville, Pa., attracted wide notice last year. Her power was increased to more than 1600 hp. Inside cargo and the barge loads this tanker can now move totals 58,000 barrels at a single trip.

### Notable Records Set

In January of 1945 the DPC steamer "Bou Arada" working for Ohio Standard came up the rivers with a tow of 16 barges which stretched ahead of the giant steamer nearly a quarter of a mile.

With a fleet of 20 towboats and 85 oil barges, serving 350 terminals in more than 250 cities, the Butcher-Arthur Co. of Houston, is doing a tremendous transportation job in moving products along the Intra-Coastal Canal between Corpus Christi, Tex., and Carrabelle, Fla., or up the Mississippi and its tributaries to Midwest and Eastern terminals, often moving as much as 3,300,000 bbls. of crude and products in a single month.

The "Tunis" alone, one of the Butcher-Arthur tow fleet, has moved 1,100,000 bbls. of crude oil for the Globe Oil Co. during the past twelve months, or a total



**Here are two views of large oil barge tows being maneuvered through the inland waterway system. When the U-boats made shipments by tanker hazardous at the start of the war great dependence was placed on oil movement by water**

# GET READY NOW TO

# LIGHT UP FOR ACTION

The day will come—soon, we hope—when the ration coupon will be history. Boarded-up service stations from coast to coast will be reopened and competitive selling will be here again. Complete service station lighting will be a powerful factor in helping you get and maintain your business. Proper lighting means rapid identification . . . for increased sales.

With long experience in applying complete lighting equipment for this special application, Westinghouse is able to provide recommendations and plans for installations in future stations.

Floodlights to emphasize completeness of service facilities and distinguish the station from competition.

Driveways free from shadows and glare, for safer and faster flow of traffic . . . Lighting on pump islands to facilitate brand recognition and servicing . . . Well-lighted display windows and cases to increase the attractiveness of auxiliary merchandise and speed selection and selling . . . Rest rooms lighted for clean and attractive appearance . . . Adequate lighting in the office and service bays for fast and accurate work . . . Westinghouse can supply all this equipment to make your station more profitable. For service station lighting aid that is complete and reliable call your Westinghouse distributor. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

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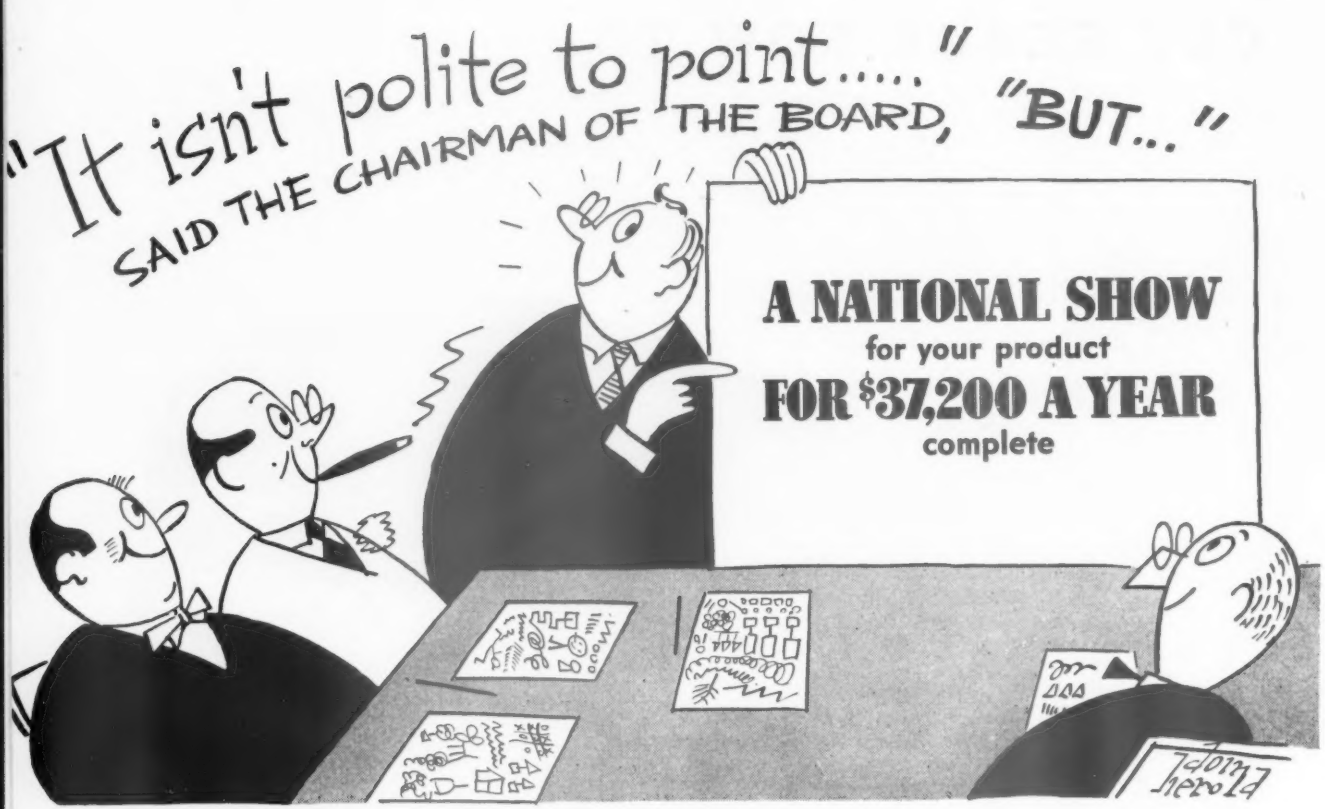
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

*Westinghouse Serves the Petroleum Industry from Drilling Rig to Service Station*




**QUICK FACTS ON REDBOOK**

Redbook buyers pay 25¢ an issue — *buy* to *read!*

High editorial percentage creates cover-to-cover interest.

Twelve insertions in Redbook give you "continuity" in your advertising at a low cost — in fact, only $37,200 a year.

25¢ selling price contributes nearly $4,000,000 toward paying for the National Show. Monthly issues guarantee longer life. Reader Research assures constant appeal.

"IF you'll sit up and take notice gentlemen — we can get down to cold fact and simple logic.

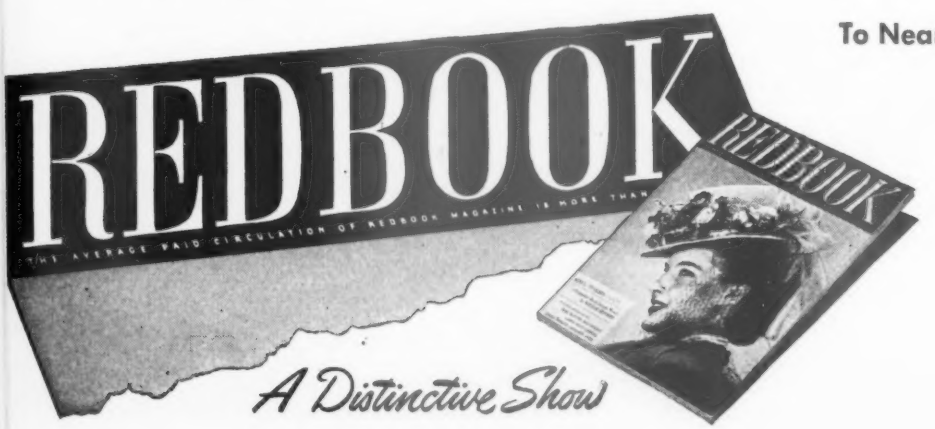
"Even when car manufacturing gets under way," (continued the Chairman of the Board) "initial production will probably be limited. Conditions will call for 'smart dollars' that know *where, when* and *how* we can do MORE advertising for LESS money.

"So why not consider the NATIONAL SHOW FOR ONLY $37,200 a year offered by REDBOOK MAGAZINE. Here is a cohesive audience of 1,500,000 families who enjoy *fine fiction* . . . the proof and criterion of their way of life . . . of their preference for good cars.

"Gentlemen, I'm no advertising expert," concluded the Chairman of the Board — "but this looks good to me!"

• • •

Even though Redbook space is sold out, at the moment, it is not too soon to make plans for the day when space is available.




**To Nearly 1/5 of America —**

**A Program of proven Sales Power**

Redbook, Cosmopolitan, and American, THE 6 MILLION GROUP, reach six million families with less than 15% duplication — approximately one out of every 5 in the United States. *And a full page in every issue of all 3 magazines costs only $160,000 a year.*

of 200,000,000 ton miles. A normal cargo being 80,000 bbls., or about 12,500 tons, she made a voyage during October of last year from New Orleans to Wood River in less than twelve days. So far as is known, the "Tunis" holds the all-time record for the largest upstream oil tow, having moved 133,000 bbls. in one voyage during December of last year to Mt. Vernon.

The big towboats on the Mississippi river and its tributaries, with their great horsepower, can push a lot of crude or products, often with eight or nine barges in a single tow, each barge containing 7500 to 10,000 bbls. of products.

The smaller tugboats are used on the Intra-Coastal Canal, having enough horsepower to move the oil barge tows through the canal from along the Texas-Louisiana Gulf Coast to Carrabelle, Fla., where there are no strong currents to contend with.

**Power Needed on Mississippi**

On the Mississippi, where it is necessary to shove upstream against a strong current, the larger river towboats are used. The average river towboat has six times the horsepower of the canal boat.

When the ice is broken for commercial traffic on the upper stretches of the Mississippi each spring, the race is on between various oil boats to reach Minneapolis and St. Paul at the head of the procession. In March this year the Hougland boats, the "Walter G. Hougland", the "Whayne H" and the "Courtney H" landed at the Twin Cities first pushing more than 100,000 barrels of gasoline. The "Bull Calf" of the Canal Barge Line, New Orleans, won praise for oil towing feats in the face of flooded rivers. The length of the rivers the fine Chotin boats at New Orleans have kept busy. So have those of A. D. Elliott of St. Marys, West Va., the Producers Pipeline Co., Owensboro, Ky., the Socony-Vacuum's popular red boats, the fleets of the Streett Towing Co., St. Louis of the Tresler Oil Co., Cincinnati, and many more.

### Lament of a Shipyard Husband

My wife's gone to work at the shipyard
And home's not the same to me.
Morning, evening and all night long
All I hear is L. S. T.

It used to be I was her first love,
And her thoughts were only of me.
But now I play second fiddle
To a boat called the L. S. T.

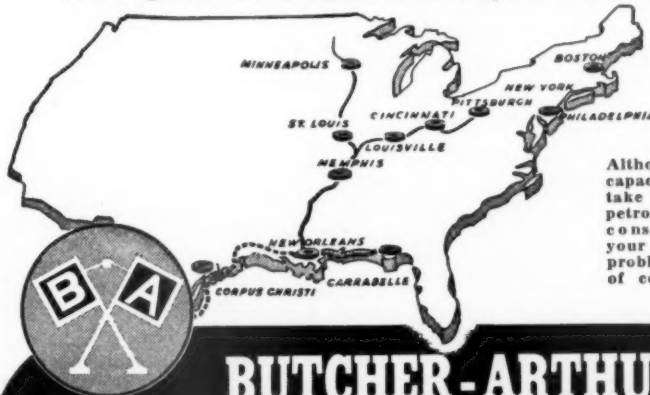
I'll be glad when this war is over
And the shipyard ceases to be.
Then maybe my wife will devote her life
To me—not an L. S. T.

—By the bard of Mt. Vernon
(Capt. W. C. Grimm,
Pilot of the M. V. Sohioan).

# Petroleum Shippers Celebrate Freedom, Too!

**July 4 has become our greatest national holiday, commemorating our independence as a nation. Born in those dark days of adversity, our still young nation has become one of the most influential leaders of the world. As we celebrate our heritage of freedom in the midst of a war to still the arms of the aggressor, it is fitting that on this July 4 we pay tribute to our forefathers and the ideals they gave us.**

**During the past three and a half years, the movement of petroleum products has been a war job of prime importance. The use of oil barges as a matter of necessity in wartime has opened the eyes of petroleum marketers to the great post-war possibilities of this dependable, thrifty method of bulk transportation. Petroleum shippers have found that, no matter what the size of shipment, movement of oil by barge gives bulk movement at bulk rates. Butcher-Arthur is proud to be one of the organizations rendering this vital wartime service, and its more than 100 boats and barges, owned and chartered, have moved as much as 3,300,000 barrels of petroleum products in a single month along the waterways of the nation.**




Although working at capacity, we can often take a spot haul of petroleum products; consult us regarding your transportation problems—no obligation, of course.

B A

**BUTCHER-ARTHUR Inc.**
and
**BUTCHER ALLIED INDUSTRIES**

301 BROADWAY HOUSTON 12, TEXAS

# Explaining Principles of Wage Stabilization

## Dealing with NWLB's Formula for Relief

*By Elwin E. Hadlick*

It was pointed out in the first of these articles on wage and salary stabilization (NPN June 19) that NWLB has four basic principles under which it may grant increases in wages and salaries. The first is for maladjustments or inequalities; the second is to eliminate sub-standards of living; the third to correct gross inequities and the fourth to aid in the effective prosecution of the war. A proper understanding of the provision for correcting gross inequities requires its subdivision into inter-plant inequities and intra-plant inequities; these are sometimes considered as two separate and distinct grounds for relief.

Mr. Hadlick

Before getting into those grounds for relief, something should be said concerning the Little Steel Formula and the place which it has in the picture. It's a much talked about but widely misunderstood subject. The formula is one set by NWLB in an early case, simply providing that a rate of pay 15% over that in effect on January 1, 1941, is a proper one. The original decision involved a large scale operation, and apparently it was thought at that time that it was appropriate for handling in that kind of a situation. Any applicant before NWLB can rely on the Little Steel Formula as a basis on which to seek relief if the basis is applicable to the particular case.

### Some Mistake Formula

The Little Steel Formula was a popular ground for application in the early days of wage stabilization. Many industries and many concerns in industry have reached or passed the limit of the formula. It is therefore no longer available for them. Many persons make the mistake of believing that the 15% over January 1, 1941 formula which is provided is the limit of what they can expect to be granted; that is a mistake. The Little Steel Formula does not restrict any of the other situations in which NWLB is entitled to grant relief.

When one comes to fill out question No. 10 on the NWLB Form 10 application, he will find that the first item is "to adjust wage or salary rates under the Little Steel Formula", but he won't find anything referring to maladjustment or inequality. It was said above that the first basis on which increases could be granted was to relieve maladjustments or inequalities. But if the form doesn't provide for making a claim on that ground, and if there is no specification of what is meant by the use of those words, an applicant is in a bad way.

The answer to the dilemma is in the Little Steel Formula. The matter of maladjustments and inequalities has resolved itself into a matter of the formula. It is for that reason that NWLB asks the question by way of referring to the formula rather than to the more technical terms of maladjustments or inequalities. When an applicant marks that portion of the form relating to the formula he is claiming that his wages or salaries represent a maladjustment or inequality within the terms of the law.

Further than that, such an applicant is adjusting his words to fit the language of NWLB. It goes without saying that an applicant who relies solely on this ground has no chance of getting approval for any rates higher than would be produced by an application of the formula; it isn't a lead-pipe cinch that NWLB will even grant full application of the formula.

**In this, his 68th in a series of war-oil compliance regulation articles, Elwin E. Hadlick, prominent Minneapolis attorney and marketing association executive, continues his discussion of the principles of wage and salary stabilization. Mr. Hadlick delves into the widely misunderstood subject of the Little Steel Formula, and goes into the principles under which NWLB grants increases in wages and salaries.**

If an applicant before NWLB is seeking approval for something more in the way of wages and salaries than what would result from application of the Little Steel Formula, he must also rely on some other ground on which the Board is permitted to grant relief. The first ground of relief has been discussed, namely, maladjustments and inequalities, now only talked about as the Little Steel Formula.

The next authorization in law is for the board to grant relief to an applicant in order to eliminate sub-standards of living. In this instance question #10 of the Form 10 application provides a direct statement of the basis in law in the words "to eliminate sub-standards of living". The applicant must know the meaning of those words if he is to have any hope of providing proof which will show that relief is available to him under this provision.

The first place to look for an explanation of what is meant by the term "sub-standards of living" is in a policy directive of the Economic Stabilization Director issued on May 12, 1943. It states that one of its purposes is to provide clear-cut guides and definite limits within which sub-standards of living may be corrected.

The directive is short but it is difficult reading; this is for the reason that it combines statements of the director's policies on several grounds for relief. To dig out those items which relate to sub-standards of living and thus to determine just what items go into making up proof that an applicant comes within this classification requires a rather complete understanding of all of the grounds of relief which are possibly available. As a matter of fact, reference to various other orders, regulations, rules, and so on, of the board is necessary to an understanding of the subject.

For example: It would be impossible to determine from a reading of the directive that any employer can make increases in wages or salaries which do not bring the rate being paid above 55c per hour, without making application or seeking approval; still since May 23, 1945 that rate has been proper; for prior dates there were other but lower rates. Neither would one determine that any rate so set which is in excess of 50c per hour may not be used as the basis for seeking either an increase in price ceilings or to resist otherwise justified reductions in price ceilings. One finds those things in General Order 30 of the board.

The question of sub-standards of living is a broad one, and most anything that will tend to show that the rates being sought are in line with the stabilized rates in the area is acceptable. Do not make the mistake, however, of talking about the cost of living when relying on the sub-standards of living ground for relief; the cost of living is presumably taken care of by the application of the Little Steel Formula.

### Explains Technical Term

In the preceding paragraph the matter of "stabilized" rates was mentioned. That again is a technical term which ought to be understood.

In the directive above referred to, the NWLB was directed to establish the wage-rate brackets embracing all those various rates found to be sound and tested going rates, such to be done by occupational groups and labor market areas. That is really a field in itself and one which has caused a lot of discussion and debate. This isn't the time nor the place to go into a discussion of the merit or lack of merit of the method

used by NWLB in determining what the sound and tested going rates are in any market or in any occupational group. It is sufficient to say that the board has determined these rates for a number of larger labor areas; the results of their studies, if available for your area, can be secured from the district office having jurisdiction over your operations.

A study of the sound and tested going rates published by the board will be extremely helpful in determining what rates might be approved. If an applicant will consider those rates in connection with the standard job classifications as determined for use by the board, he will probably do a pretty fair job of making out a case on the basis of sub-standards of living.

This leaves for consideration in the next article the applications which are grounded on a claim to correct gross inequities or on one to aid in the effective prosecution of the war.

## Index of Week's War-Oil Orders

(June 23-30, 1945)

**PAW—Petroleum Administration for War**

**Dist. 2 Wire Directive**—Restrictions on use of tetraethyl lead

**Pri. Circular 8 as am. 6-9-45**—Relation of P-98-b to U-2 and U-3

**Petroleum Directive 80, as am. 6-30-45**—Reference to road oil removed from asphalt directive

**OPA—Office of Price Administration**

**2nd Rev. SO 76, Am. 2**—One price regulation for all services of a supplier

**MPR 136, RPS 42, Am. 8**—Paraffin wax

**Am. 5**—Machines, parts and industrial equipment

**RMPR 165, Am. 10**—Service ceilings

**RMPR 528, Am. 2**—Ceilings on tube repairs, used tires, basic carcasses, retreading, repairing, and repair materials

**Rev. RO 5C, Am. 9**—Exemption from fleet delivery record requirements

**RO 9A, Am. 22**—Stove rationing

**Rev. RO 11, Am. 60**—Use of slow curing road oil for surfacing or maintaining roads prohibited

**DSC—Defense Supplies Corporation**

**Letter to Applicants under Reg. 7**—Time limit on filing of claims

**WPB—War Production Board**

**L-347**—Measuring and dispensing pumps restrictions revoked

**M-38 as am. 6-25-45**—Lead allocation

**M-300, Schedule 71 as am. 6-25-45**—Ethyl alcohol

**CMP Reg. 1, Direction 44, Revocation**—Dir. 44 now incorporated in CMP 1

**Interp. 32**—Effect of Pri. Reg. 1 on sale of B products

**Pri. Reg. 12, Direction 1**—Rerating of third quarter production schedules

**Pr. Reg. 13, Direction 1 as am. 6-28-45**—Spot authorizations direction expired 6-30-45.

**Pri. Reg. 25 as am. 6-28-45**—Spot authorizations for production

**Pri. Reg. 27 as am. 6-21-45**—Manufacturers' priorities for small amounts of materials

**SPB—Surplus Property Board**

**Reg. 6, Order 1**—Disposal of emergency plant facilities

**Reg. 9**—Contractor inventory and disposals by owning agencies

**NWLB—National War Labor Board**

**GO 4, Am.**—Exception to exemption provisions

**CONGRESS OF U. S.**

**Report of Chairman Ways & Means Comm. on House Concurrent Resolution 50**—Deduction of intangible drilling and development costs as an expense

**Senate Finance Comm. Report on H. Con. Res. 50**—Intangible drilling costs

**CODE: AO—Administrative Order; CMP—Controlled Materials Plan; D—Directive; FDO—Food Distribution Order; GMPR—General Maximum Price Regulation: GO—General Order: Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order: PAO—Petroleum Administrative Order: Pri. Reg.—Priorities Regulation: Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.**

## Digest of Week's War-Oil Orders

### Petroleum Administration for War

**RESTRICTIONS ON USE OF TETRAETHYL LEAD—Dist. 2 Wire Directive**—Tetraethyl lead may not be used in manufacture of any civilian product except premium (76 oct.), housebrand (70 oct.), third grade (70 oct.), or required volumes of aviation gasoline. No one may use, in the manufacture of premium motor fuel, any aviation gasoline, naphtha, or gasoline to which tetraethyl lead has been added, except within the premium motor fuel quota permitted by PDO 21. Issued and effective 6-25.

**RELATION OF P-98-b to U-2 and U-3—Pri. Circ. 8 as am. 6-9-45**—Material for initial installation of privately owned telegraph, telephone, or teletype lines and facilities may be obtained by petroleum operators under P-98-b if material cost for one complete operation does not exceed $25,000. When it exceeds $25,000 the operator must file with Washington PAW an application on PAW Form 30 both for authority to use the material and for all necessary priorities assistance. Issued 6-9.

**REFERENCE TO ROAD OIL REMOVED FROM ASPHALT DIRECTIVE—Directive 80 as am. 6-30-45**—Reference to road oil removed from Directive 80, as it is now fully covered by revised Dir. 72 and Rev. RO 11. Issued and effective 6-30.

### Office of Price Administration

**ONE PRICE REGULATION FOR ALL SERVICES OF A SUPPLIER—2nd Rev. SO 76, Am. 2**—Services subject to MPR 581 (industrial services) added to group to which one price regulation may be applied. The Price Administrator, a regional administrator, or a district director may require any person to apply the provisions of one regulation mentioned in SO 76 to services subject to two or more of the regulations so mentioned. Issued 6-23, effective 6-28.

**PARAFFIN WAX—RPS 42, Am. 8**—Kalamazoo Paraffine Co. may add to ceiling price set by RPS 42 the freight from source to Kalamazoo, plus $0.005 per lb. on quantities of 10,000-20,000 lbs., and $0.0025 for quantities over 20,000 lbs. Issued 6-23, effective 6-28.

**MACHINES, PARTS, AND INDUSTRIAL EQUIPMENT—RMPR 136, Am. 5**—RMPR 136 applies to sales of electric storage batteries, electric fuses and wiring devices to industrial, commercial, or governmental users, but not to sales to any other type of user. Issued 6-25, effective 6-30.

**SERVICE CEILINGS—RMPR 165 Am. 10**—Unless authorized by OPA, service suppliers may not require a deposit for any reason, or make an extra charge for insurance, if none was made in March, 1942, and any then made may not now be increased. Issued 6-27, effective 7-2.

**CEILINGS ON TUBE REPAIRS, USED TIRES, BASIC CARCASSES, RETREADING, REPAIRING, AND REPAIR MATERIALS—RMPR 528, Am. 2**—Suppliers of an extra service (such as road service, mounting, demounting, pick-up and delivery) in connection with repair of a tube may apply to OPA for an adjustment of established ceiling. A number of changes are made in ceilings on used tires, basic carcasses, repair materials, to bring them more in line with general level of prices elsewhere in RMPR 528.

**EXEMPTION FROM FLEET DELIVERY RECORD REQUIREMENTS—Rev. RO 5C, Am. 9**—Industrial users of non-highway gasoline rations who use E and R coupons in buying gasoline at scattered points may be exempted by District Director from maintaining delivery records, if such users require a non-highway ration of E and R coupons for use in ten or more separate machines or pieces of equipment by ten or more employees at ten or more different locations. Issued 6-26, effective 6-29.

**STOVE RATIONING—RO 9A, Am. 22**—Oil cooking stoves added to those stoves for which certificates may be given only if outside emergency oil shortage area, or within that area to replace oil-heating equipment, or if coal or wood are insufficient for the purpose. Dealers and distributors may discontinue keeping a record of invoices of stoves transferred or acquired, and of orders for coal or wood stoves placed with them after they have filled all orders for such stoves which were accompanied by certificates and filed by 11-1-44. Issued 6-21, effective 6-25.

**USE OF SLOW CURING ROAD OIL FOR SURFACING OR MAINTAINING ROADS PROHIBITED—Rev. RO 11, Am. 60**—To conform the fuel oil rationing order to Petroleum Directives 72 and 80 (road oil and asphalt), the use of slow curing road oil is prohibited for the production of a paving product, for use as a dust palliative or road surfacer. Issued 6-28, effective 7-2.

### Defense Supplies Corporation

**TIME LIMIT ON FILING STRIPPER WELL CLAIMS—Letter to Reg. 7 Applicants**—No more claims will be accepted for payment by DSC unless filed within Reg. 7's time limit—the 20th day of the second month following the month covered by the claim. Supplemental claims filed after 7-1-45 will be accepted for payment only if filed within six months from

**OIL-LAW-Gram Service**

**Complete texts of all orders or amendments digested in war-oil orders can be had from Platt's Oil-LAW-Gram, 1213 West 3rd street, Cleveland 13, Ohio. Minimum charge single copies $1. Copies of these texts are always in stock but large orders can be promptly filled by reprinting as plates and stencils are also kept.**

**Complete daily Oil-LAW-Gram service, with necessary binders, $100 per year in advance.**

**Due care and judgment have been taken in preparing and publishing these digests and in reproducing the original texts but the publisher does not warrant their absolute legal completeness nor accuracy. Important decisions by the reader should be made only after careful study of complete texts.**

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*sell your customers*

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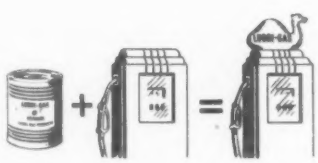
PROCESSED GASOLINE

## THE PREMIUM PLUS GASOLINE

Any 68 to 72 octane gas treated with Lubri-Gas gives premium motor performance.

### WHAT LUBRI-GAS IS

Lubri-Gas is essentially a 40SAE Lubricating Oil processed with a detergent and other gum and carbon inhibiting chemicals so that the treated oil mixes freely with the motor fuel, and lubricates the motor parts which otherwise would be without this needed protection.

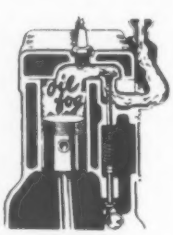


### WHAT LUBRI-GAS DOES

Lubri-Gas enters the combustion chamber in the form of a fine oily mist or fog. This fog will not burn at motor temperature. It condenses back to clean oil and bathes the valves, sparkplugs, cylinder walls, pistons and piston rings with a protective film.

Carbon, gum and sludge are loosened and discharged through the exhaust.

Sticky valves are freed—Knocks disappear—motor runs cooler with more power and gives MORE MILES PER GALLON.



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*is Premium Plus*
*because it is not only Anti-Knock, but also Anti-Friction, Anti-Carbon, Anti-Gum, Anti-Sludge.*

***Cleans and Lubricates as It Powers Your Motor***




last day of month covered by claim, accompanied by satisfactory explanation of non-inclusion in original claim. Extensions of filing time of original claims are granted under unusual circumstances, but must be made several days before expiration date of specified time for filing. Issued 6-14.

## War Production Board

**MEASURING AND DISPENSING PUMPS RESTRICTIONS REVOKED—L-347, Revocation**—Issued and effective 6-27.

**LEAD ALLOCATION—M-38 as am. 6-25-45**—Amount of lead permitted for industrial type batteries during 3rd quarter 1945 remains unchanged. The 25% of amount used for automotive SLI type during 1944, allocated for 3rd quarter 1945, represents an increase (formerly 40% per quarter of amount used in first 6 mos. 1944). Issued 6-25.

**ETHYL ALCOHOL—M-300, Schedule 71 as am. 6-25-45**—Recently inserted paragraph concerning imported cane alcohol deleted entirely from M-300. Issued 6-25

**DIRECTION 44 NOT NECESSARY UNDER CMP REG. 1, AS REVISED—CMP Reg. 1, Dir. 44, Revocation**—Provisions concerning sale of steel not needed by producers and distributors to fill authorized orders no longer necessary under modified Reg. 1. Issued 6-26, effective 7-1.

**EFFECT OF PRI. REG. 1 ON SALE OF B PRODUCTS—CMP Reg. 1, Interp. 32**—Despite Pri. Reg. 1's restrictions on disposal of material or products in which it is incorporated which can no longer be used for purpose originally intended, any Class B product manufactured on an authorized production schedule may be sold to fill any orders received, whether rated or unrated, as long as rated orders are given the preference required by Pri. Reg. 1 or other applicable regulations. Where WPB gives special priorities assistance to get materials for a B product order for a certain customer or use (as Navy, Army, etc.) then the product, if unusable, and left over material may be disposed of only under Pri. Reg. 1. Issued 6-26.

**RERATING OF THIRD QUARTER PRODUCTION SCHEDULES—Pri. Reg. 12, Dir. 1**—No one who is or has been assigned a new preference rating under CMP regulations for his third quarter production schedule is required to rerate purchase orders for materials which he has placed prior to receipt of the new rating. New ratings assigned on any CMP authorization must, however, be applied on all orders placed after receipt of the new rating. Issued 6-28.

**SPOT AUTHORIZATIONS DIRECTION EXPIRED 6-30-45—Pri. Reg. 13, Dir. 1 as am. 6-28-45**—Provisions concerning Z allotment symbol orders and Pri.-Reg.-25-authorized production schedules' relation to special sales rules of Pri. Reg. 13 no longer applicable because of revision of Pri. Reg. 25. Issued 6-28, effective 6-30.

**SPOT AUTHORIZATIONS FOR PRODUCTION—Pri. Reg. 25 as am. 6-28-45**—The revised spot authorization method for getting permission to produce a product still restricted by certain orders no longer provides for preference ratings and allotments along with the spot authorization. A spot authorization provides an exemption from the provisions of orders which refer to Pri. Reg. 25 and those listed in Direction 1 to Pri. Reg. 25, which relief is automatically extended to any subcontractor furnishing the authorization-holder with a Class A component of restricted product. Issued 6-28.

**MANUFACTURERS' PRIORITIES FOR SMALL AMOUNTS OF MATERIALS—Pri. Reg. 27 as am. 6-21-45**—Manufacturers with a total production of not over $50,000 per quarter are now granted a rating of AA-4 for relatively small amounts of production materials under Pri. Reg. 27, as well as the right to place controlled material orders under CMP, allotment symbol Z-3. This procedure may be used even if other ratings or allotments have been given by WPB, but all such production

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They call it the Burma Road of the Air because three-quarters of all the vital war supplies, flown over the towering Himalayas into China, have been transported in the Curtiss Commando. Little wonder that this mighty twin-engined transport is known as today's great lifeliner, tomorrow's great airliner.

And less wonder that Curtiss-Wright selected Bowser Xacto Meters for testing fuel flow and consumption, gross weights, and center of gravity locations for stability and control for the Curtiss Commando.

Carrying vital cargos of war-winning materiel and personnel over thousands of air miles demands that those vital calculations be measured with hairline accuracy because lives . . . American lives and thousands of them . . . hang in that exacting balance.

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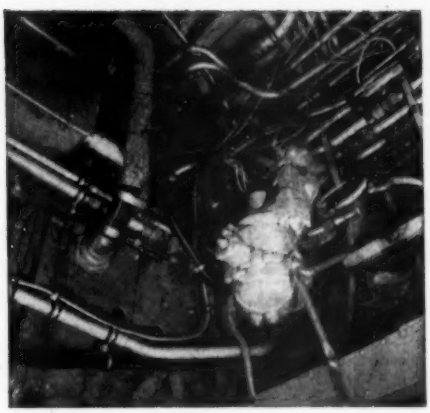

The Bowser XACTO Meter Installation In The Curtiss Commando

Not only has Bowser war production earned the Army-Navy E... Bowser equipment has helped earn it for scores of other companies.

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must be included under the $50,000 limit. Form of certification, special procedures for A product manufacturers, and relation to other WPB regulations are also outlined. Issued 6-21.

## Surplus Property Board

**DISPOSAL OF EMERGENCY PLANT FACILITIES—SPB Reg. 6, Order 1**—Equipment of plants constructed or equipped under Emergency Plant Facilities Contract (5-year reimbursement of contractor by Government) is subject to disposal under Reg. 6 except in cases where contract includes land on which buildings or facilities are erected. Issued and effective 6-22.

**CONTRACTOR INVENTORY AND DISPOSALS BY OWNING AGENCIES—SPB Reg. 9**—Reg. 9 supersedes SWPA Reg. 1 and SWPA statement of policies to be followed by government agencies in sale of contract termination inventories. Covers contractor inventory retentions and sales at cost, retentions by contractors for own use, small lot and inventory sales by contractors, disposal of serviceable and unserviceable property, used and worthless property. Owning agency sales of small lots, waste, and salvage, emergency disposal, destruction, and abandonment also covered. Issued 6-7, effective 7-1 and 8-1.

## National War Labor Board

**EXCEPTION TO EXEMPTION PROVISIONS—GO 4, as am. 6-6-45**—The general automobile repair industry in metropolitan Chicago, Milwaukee, Wis., Indianapolis, Ind., Twin Cities, Minn., and in Peoria, Ill., is not exempted from complying with NWLB GO 4's rules concerning raises in pay, etc., even though employing under 8 persons. Approved 6-6, published 6-12.

## Congress of United States

**DEDUCTION OF INTANGIBLE DRILLING AND DEVELOPMENTS COSTS AS AN EXPENSE—Report of Chrmn. of Ways & Means Comm. on House Concurrent Res. 50**—Recommends that amendment recognizing and approving Treasury Regs. 111 and prior regulations permitting deduction of intangible drilling and development costs as an expense in filing of income tax declarations be passed. Issued 6-19.

**INTANGIBLE DRILLING COSTS—Senate Finance Comm. Report on House Con. Res. 50**—Recommended for passage, without amendment, because committee believes it was intent of Congress, as reflected in Treasury regulations, to give taxpayer option to capitalize or charge such costs to expense in the case of oil or gas wells. Issued 6-22.

## No Reduction Contemplated On Oil Subsidy Payments

*Special to NPN*

OIL CITY, Pa.—O. D. Judd, OPA fuel administrator, said last week that neither OPA nor Judge F. N. Vinson, economic stabilizer, contemplates a reduction in the oil subsidy payment for stripper well production during the war emergency.

Judd issued the statement to J. P. Jones of Bradford, Pa., director of production for the Pennsylvania Grade Crude Oil Assn. The price official acted to spike rumors that the current subsidy to Penn Grade Region oil producers is being reconsidered with a view to downward revision. The current program provides for payments ranging from 35c per bbl. in the western field to 75c per bbl. in the Penn Grade Region.

## ODT Outlines Rules For Tire Casing Care

NPN News Bureau

WASHINGTON—The Office of Defense Transportation last week called production of complete casings "the real bottleneck in the flow of tires to users," and outlined rules for the case of tire casings before and after recapping.

"The first rule of good tire care," the agency said, "is to remove a tire for recapping when the tread is smooth over ¾ of its width and when there is 1/10 to ⅛ inch of tread rubber over the breaker strips (the outside layer of tire fabric). The under-tread thickness may be somewhat less for passenger car tires. For best results, however, tires should not be used until the breaker strip is exposed, because this greatly increases the possibilities of cut and water damage to the casing fabric and may later result in premature failure of the recapped tire.

## 10% Reduction of Freight Rate Surcharge Announced by WSA

NPN News Bureau

WASHINGTON—A reduction of 10% in tanker freight rate surcharges on movement of bulk liquid cargoes over various Western Hemisphere routes was announced this week by the War Shipping Administration.

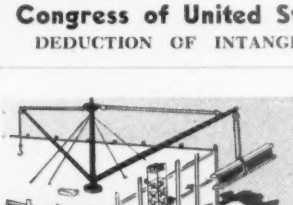
A uniform and considerably reduced surcharge of 10% was ordered on basic freight rates on petroleum and products moving to and between ports outside the Continental United States, eliminating many individual and widely variant surcharges heretofore in effect. Surcharges are also reduced to the 10% level in the case of many other bulk liquid cargoes, such as creosote and benzol, while certain changes are made in basic freight rates for the South American trades and a new scale of small tanker rates has been fixed for operations to the Windward and Leeward Island, British Guiana, and Netherlands Guiana.

All changes are effective on tanker cargoes whose loading was completed on or after July 1, 1945.

## Spacing Permits Issued For Kansas Fields

NPN News Bureau

CHICAGO—Petroleum Administrative Letters 69 and 70 have been issued by C. C. Brown, director of production, PAW Dist. 2, effective June 28. Optional diagonal or center spacing of wells in the northeast or southwest quarter-quarter section of the Hammer Field, Barton County, Kansas, is permitted by Administrative Letter 69 and optional center or diagonal spacing of wells in the northwest or southwest quarter-quarter section of the Clearwater Field, Sedgwick County, Kansas, is permitted by Administrative Letter 70.

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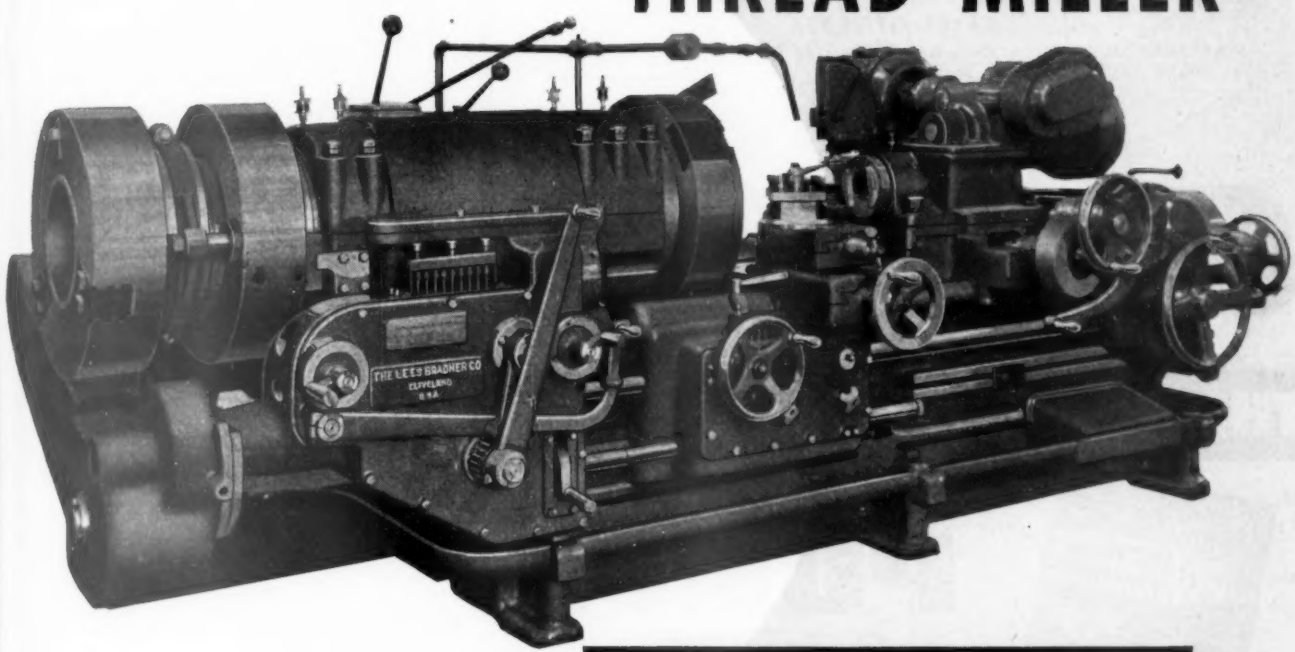
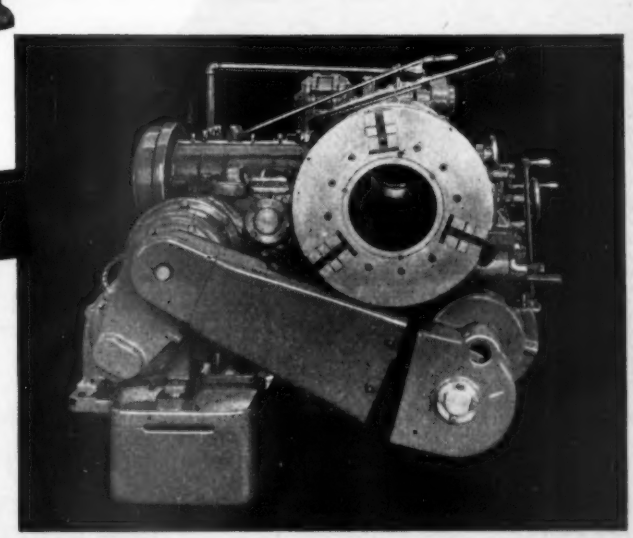



CAPACITY

Steel—2 threads per inch with 8½ inch face



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## OPA Granted Extension In Hughes Oil Co. Suit

NPN News Bureau

CHICAGO—OPA late last week was granted extension to and including July 20, in which to file a 'bill of particulars' in its treble damage suit against the Hughes Oil Co., for alleged price violations. Federal Judge Sullivan in preliminary hearings had required OPA to submit particulars by June 28, to clarify the charges against Hughes.

The Hughes Oil Co. is one of five Midwest oil companies named in treble damage suits by OPA for alleged over-ceiling prices.

## Coming Meetings

OCTOBER

Indiana Independent Petroleum Assn., fall convention, Hotel Severin, Indianapolis, Oct. 10-11.

NOVEMBER

South Dakota Oil Men's Assn., fall convention, Watertown, S. D., Nov. 26-27. Tentative.

DECEMBER

Nebraska Petroleum Marketers, Dec. 4-5-6.
Wisconsin Petroleum Marketers, Dec. 11-12.

## Market Reports

ATLANTIC COAST—A supplier offering 5c discount on Bunker C when from Navy storage at New York and Norfolk to outgoing vessels has discontinued his discount and is now offering the product at a flat price of $1.72. Since previous price was $1.77 less discount, no actual change in price is being made.

Kerosine supplies are somewhat easier, according to one supplier in New York, who said, however, it was not likely that any stockpile could be acumulated until at least the end of July.

° ° °

CALIFORNIA—No price changes reported. With the exception of gasoline, practically all petroleum products remained in short supply. However, heating fuels had eased somewhat due to warm weather. Service station reopenings in the five western states during May totaled 52 compared with 86 in April. Stations still closed in the five western states on June 1 numbered 4,656, compared with 5,389 a year earlier.

° ° °

GULF COAST—A New Orleans refiner reported heavy calls from eastern marketers for premium gasoline, but said supplies were unavailable. He also reported having difficulty in getting barge movement up to Cincinnati and Louisville. Tank car availabilty continues tight.

° ° °

MIDCONTINENT—No price changes or open spot sales were reported during the week. Refiners are looking for reduction in 702 Navy Diesel program to give them a chance to accumulate some burning oil stocks for next winter. Transportation is termed "smoothest in a long time" by many refiners.

A decided increase in call for gasoline was apparent, refiners said, preventing several from building inventory. Heavy fuel is reported "tight" with railroads taking all refiners can give them.

No open spot sales were reported on Grade 26-70 natural gasoline during the week. Sellers reported quoting 4.5c FOB Group 3, and 4.125c FOB Breckenridge.

° ° °

MIDWEST—Midwest refiners and marketers anxiously await cutbacks of Navy 702 Diesel and Pool 21 gas oil programs from 45,000 b/d to 20,000 b/d in Dist. 2. Cutback is expected to come early in July and will allow accumulation of burning oil stocks in this District. Not so advantageous to the marketers, it will only allow them to get supplies here and cut off supplies that were obtained in Dist. 3, where cutback will draw more supplies for the Navy's requirements.

Marketers report that regular is becoming hard to obtain due to increased shipments to the East where top ceiling price is being paid for gasoline. There is a sizable increase in gasoline demands, refiners and marketers say, attributing the situation partially to increased civilian rations and partially to motorists using cars who have not done so during the past winter.

Scarcity of heavy fuel oils has been reported to be still acute (OPA last week cut heavy fuel oil rations by one-third) and inquiries are still coming in from Dist. 1, but shortage here requires all possible material.

Market continues extremely tight.

° ° °

PENNSYLVANIA—No price changes were reported. Refined products continued tight with little change in supply and demand situation. A sale of ten cars No. 2 fuel at 6.75 cents was reported by one refiner. Paraffin wax and petrolatums continued on heavy call.

### N.P.N. Gasoline Index

| | Dealer T.W. | Tank Car |
|---|---|---|
| | Cents Per Gal. | |
| July 2 | 10.27 | 6.72 |
| Month ago | 10.27 | 6.72 |
| Year ago | 10.51 | 6.88 |

Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

### Daily Av. Pennsylvania Crude Runs

*(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)*

| Week Ended June 23, 1945 | Week Ended June 16, 1945 | Week Ended June 24, 1944 |
|---|---|---|
| 67,205 | 64,765 | 72,244 |

### CRUDE PRICES

Since changes in crude oil prices are so few, the two pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers. Changes in crude oil prices will be specially noted in this market section when made.

**Crude Price Changes**

*No price changes reported in week ending June 27.*

*For latest table of crude prices published, see NPN June 27, pages 57, 58 and 55.*

### Summary of Daily Gasoline Prices (June 25 to July 2)

| | Monday July 2 | Friday June 29 | Thursday June 28 | Wednesday June 27 | Tuesday June 26 |
|---|---|---|---|---|---|
| **U. S. Motor (ASTM octane)** | | | | | |
| **76 octane Ethyl:** | | | | | |
| Oklahoma | 6.75 | 6.75 | 6.75 | 6.75 | 6.75 |
| Mid-Western (Group 3 basis) | 6.75 | 6.75 | 6.75 | 6.75 | 6.75 |
| N. Tex. (For shpt. to Tex. & N. M. dest'ns.) | - | - | - | - | 7 |
| W. Tex. (For shpt. to Tex. & N. M. dest'ns.) | 7 (2) | 7 (2) | 7 (2) | 7 (2) | 7 (2) |
| **70-74 octane:** | | | | | |
| Oklahoma | 5.875 | 5.875 | 5.875 | 5.875 | 5.875 |
| Mid-Western (Group 3 basis) | 5.875 | 5.875 | 5.875 | 5.875 | 5.875 |
| N. Tex. (For shpt. to Tex. & N. M. dest'ns.) | 5.875 | 5.875 | 5.875 | 5.875 | 5.875 |
| W. Tex. (For shpt. to Tex. & N. M. dest'ns.) | 5.875 | 5.875 | 5.875 | 5.875 | 5.875 |
| **63-66 octane:** | | | | | |
| Oklahoma | 5.625 (1) | 5.625 (1) | 5.625 (1) | 5.625 (1) | 5.625 (1) |
| Mid-Western (Group 3 basis) | 5.625 (2) | 5.625 (2) | 5.625 (2) | 5.625 (2) | 5.625 (2) |
| N. Tex. (For shpt. to Tex. & N. M. dest'ns.) | 5.625 (1) | 5.625 (1) | 5.625 (1) | 5.625 (1) | 5.625 (1) |
| W. Tex. (For shpt. to Tex. & N. M. dest'ns.) | 5.625 (2) | 5.625 (1) | 5.625 (1) | 5.625 (1) | 5.625 (1) |
| **60 octane & below:** | | | | | |
| Oklahoma | 5.25 | 5.25 | 5.25 | 5.25 | 5.25 |
| Mid-Western (Group 3 basis) | 5.2 - 5.25 | 5.2 - 5.25 | 5.2 - 5.25 | 5.2 - 5.25 | 5.2 - 5.25 |
| N. Tex. (For shpt. to Tex. & N. M. dest'ns.) | 5.2 - 5.25 | 5.2 - 5.25 | 5.2 - 5.25 | 5.2 - 5.25 | 5.2 - 5.25 |
| W. Tex. (For shpt. to Tex. & N. M. dest'ns.) | 5.25 | 5.25 | 5.25 | 5.25 | 5.25 |
| **Motor Gasoline, 70-74 oct.** | | | | | |
| New York harbor | 9.075 | 9.075 | 9.075 | 9.075 | 9.075 |
| New York harbor, barges | 8.5 - 8.975 | 8.5 - 8.975 | 8.5 - 8.975 | 8.5 - 8.975 | 8.5 - 8.975 |
| Philadelphia district | 9.075 | 9.075 | 9.075 | 9.075 | 9.075 |
| Baltimore district | 8.825 | 8.825 | 8.825 | 8.825 | 8.825 |
| **Motor Gasoline:** | | | | | |
| **Western Penna. Bradford-Warren:** | | | | | |
| "Q" Gasoline, Min. 70 Oct. (ASTM) | 7.625- 8.225 | 7.625- 8.225 | 7.625-8.225 | 7.625- 8.225 | 7.625- 8.225 |
| **Western Penna. Other Districts:** | | | | | |
| "Q" Gasoline, Min. 70 Oct. (ASTM) | 7.725 | 7.725 | 7.725 | 7.725 | 7.725 |

Note: To conform with Article IV of MPR 88 as amended August 15 we are substituting 70-74 oct. ASTM for the old 72-74 oct. ASTM. We continue to include in this group, Housebrand quotations.

## Pacific Coast Demand

*(Bureau of Mines figures in thousands of bbls. daily)*

| | Gasoline | | Gas Oil & Diesel | | Heavy Fuel Oil | | All Products | |
|---|---|---|---|---|---|---|---|---|
| | 1944 | 1945 | 1944 | 1945 | 1944 | 1945 | 1944 | 1945 |
| January | 275 | 304 | 103 | 104 | 505 | 545 | 993 | 1,066 |
| February | 315 | 315 | 109 | 100 | 478 | 594 | 1,011 | 1,124 |
| March | 311 | 332 | 108 | 94 | 479 | 519 | 1,018 | 1,068 |
| April | 302 | 406 | 58 | 83 | 450 | 536 | 954 | 1,148 |
| May | 295 | | 85 | | 411 | | 900 | |
| June | 352 | | 87 | | 395 | | 969 | |
| July | 335 | | 63 | | 353 | | 884 | |
| Aug. | 329 | | 63 | | 349 | | 883 | |
| Sept. | 328 | | 65 | | 382 | | 902 | |
| Oct. | 313 | | 70 | | 450 | | 945 | |
| Nov. | 328 | | 80 | | 467 | | 992 | |
| Dec. | 319 | | 101 | | 558 | | 1,093 | |
| Jan.-April | 300 | 339 | 102 | 95 | 478 | 548 | 994 | 1,101 |

## Mid-Continent Lube Statistics (March 1945)

*(Compiled by Western Petroleum Refiners Assn. from reports of member companies. Figures in bbls. of 42 gal.)*

| | Bright Stock | Viscous Neutrals | Paraffin Oils | Steam Refined Stock | Blended Oils |
|---|---|---|---|---|---|
| Production | 281,624 | 319,438 | 88,545 | 24,292 | 411,964 |
| Shipments: | | | | | |
| Domestic | 280,585 | 354,266 | 97,704 | 19,941 | 400,568 |
| Export | 5,010 | 642 | 39 | 146 | 1,546 |
| Total | 285,595 | 354,908 | 97,743 | 20,087 | 402,114 |
| Inventory March 31 | 213,459 | 245,030 | 38,288 | 33,098 | 141,646 |

## Pennsylvania Lubricating Oils

*(Compiled by National Petroleum Assn. from reports of companies refining Pennsylvania Grade crude oil. Figures in bbls.)*

| | Production April 1945 | Inventory April 1945 | Production March 1945 | Inventory March 1945 |
|---|---|---|---|---|
| Raw Long Residuum | 41,458 | 36,188 | 39,223 | 45,391 |
| 600 Steam Refined Stock | 256,618 | 105,327 | 258,059 | 125,754 |
| Other Steam Refined Stock | 40,629 | 32,387 | 51,395 | 49,246 |
| Finished dewaxed Long Residuum | 35,867 | 37,518 | 41,806 | 37,707 |
| Bright Stock | 177,292 | 198,232 | 147,460 | 221,188 |
| Viscous Neutral (below 180 Vis.) | 53,168 | 118,506 | 63,850 | 113,523 |
| Viscous Neutral (180 Vis. at 100) | 98,700 | 97,153 | 91,540 | 101,009 |

## Production of Natural 'Gas,' Allied Products

| | March 1945 | Feb. 1945 |
|---|---|---|
| East Coast | | |
| W. New York | | |
| W. Pennsylvania | 1,497 | 1,518 |
| West Virginia | 7,864 | 7,885 |
| Ohio | 610 | 678 |
| Illinois | 15,428 | 14,110 |
| Kentucky | 4,438 | 3,623 |
| Michigan | 1,126 | 1,027 |
| Kansas | 5,694 | 5,930 |
| Oklahoma | 35,120 | 321,925 |
| Texas | 181,994 | 169,094 |
| Gulf | 45,019 | 42,874 |
| East Texas | 31,254 | 28,652 |
| Panhandle | 45,799 | 44,595 |
| Other | 59,922 | 52,973 |
| Arkansas | 7,567 | 6,996 |
| Louisiana | 49,791 | 45,104 |
| Gulf | 28,416 | 26,175 |
| Inland | 21,375 | 18,929 |
| New Mexico | 8,531 | 5,987 |
| Colorado | ° | ° |
| Montana | 508 | 428 |
| Wyoming | °4,816 | °4,514 |
| California | 74,980 | 67,813 |
| Total | 399,964 | 367,632 |
| Daily average | 12,902 | 13,130 |
| Total (thousands of bbls.) | 9,523 | 8,753 |
| Daily average | 307 | 313 |

° Wyoming includes Colorado drip gasoline.

## Dealer and Service Station Gasoline Prices in 50 Representative U. S. Cities October 1, 1944

| City | Dealers' Net Price (Ex. Tax) | Service Station (Ex. Tax) | Gasoline Tax (Inc. 1½ Cent Federal Tax) | Service Station (Inc. Tax) |
|---|---|---|---|---|
| Portland, Me. | 10.80 | 4.0 | 5.5 | 20.30 |
| Manchester, N. H. | 11.80 | 4.1 | 5.5 | 21.40 |
| Burlington, Vt. | 11.40 | 4.0 | 5.5 | 20.90 |
| Boston, Mass. | 10.40 | 4.0 | 4.5 | 18.90 |
| Providence, R. I. | 10.50 | 4.2 | 4.5 | 19.20 |
| Hartford, Conn. | 11.10 | 4.0 | 4.5 | 19.60 |
| Buffalo, N. Y. | 10.10 | 4.2 | 5.5 | 19.80 |
| New York, N. Y. | 10.60 | 5.4 | 5.5 | 21.50 |
| Newark, N. J. | 10.20 | 5.0 | 4.5 | 19.70 |
| Philadelphia, Pa. | 10.20 | 4.2 | 5.5 | 19.90 |
| Dover, Del. | 10.70 | 4.3 | 5.5 | 20.50 |
| Baltimore, Md. | 9.95 | 4.05 | 5.5 | 19.50 |
| Washington, D. C. | 10.20 | 4.0 | 4.5 | 18.70 |
| Charleston, W. Va. | 11.65 | 4.05 | 6.5 | 22.20 |
| Norfolk, Va. | 10.45 | 5.55 | 6.5 | 22.50 |
| Charlotte, N. C. | 11.70 | 4.0 | 7.5 | 23.20 |
| Charleston, S. C. | 10.55 | 4.75 | 7.5 | 22.80 |
| Atlanta, Ga. | 11.10 | 4.0 | 7.5 | 22.60 |
| Jacksonville, Fla. | 10.10 | 4.0 | 8.5 | 22.60 |
| Birmingham, Ala. | 10.00 | 5.0 | 8.5 | °23.50 |
| Vicksburg, Miss. | 9.50 | 5.0 | 7.5 | 22.00 |
| Memphis, Tenn. | 8.90 | 4.5 | 8.5 | 21.90 |
| Lexington, Ky. | 10.50 | 3.5 | 6.5 | 20.50 |
| Youngstown, Ohio | 9.50 | 3.0 | 5.5 | 18.00 |
| South Bend, Ind. | 10.50 | 4.5 | 5.5 | 20.50 |
| Chicago, Ill. | 9.60 | 2.76 | 4.5 | 16.86 |
| Detroit, Mich. | 9.90 | 3.74 | 4.5 | 18.14 |
| Milwaukee, Wisc. | 10.60 | 4.3 | 5.5 | 20.40 |
| Twin Cities, Minn. | 10.40 | 4.5 | 5.5 | 20.40 |
| Fargo, N. Dak. | 11.40 | 4.0 | 5.5 | 20.90 |
| Huron, S. Dak. | 10.80 | 3.7 | 5.5 | 20.00 |
| Omaha, Neb. | 9.60 | 3.0 | 6.5 | 19.10 |
| Des Moines, Ia. | 9.90 | 3.5 | 4.5 | 17.90 |
| St. Louis, Mo. | 9.50 | 3.0 | 4.5 | °17.00 |
| Wichita, Kans. | 8.80 | 3.2 | 4.5 | 16.50 |
| Tulsa, Okla. | 8.00 | 3.0 | 7.0 | 18.00 |
| Little Rock, Ark. | 9.50 | 4.5 | 8.0 | 22.00 |
| New Orleans, La. | 8.75 | 4.75 | 8.5 | 22.00 |
| Houston, Texas | 8.50 | 4.5 | 5.5 | 18.50 |
| Albuquerque, N. Mex. | 10.50 | 4.5 | 7.0 | °°22.00 |
| Denver, Colo. | 10.00 | 4.0 | 5.5 | 19.50 |
| Casper, Wyo. | 11.50 | 5.0 | 5.5 | 22.00 |
| Butte, Mont. | 9.50 | 4.0 | 6.5 | 20.00 |
| Boise, Ida. | 13.50 | 4.0 | 6.6 | 24.10 |
| Salt Lake City, Utah | 13.50 | 4.5 | 5.5 | 23.50 |
| Reno, Nev. | 12.00 | 4.0 | 5.5 | 21.50 |
| Phoenix, Ariz. | 12.00 | 4.0 | 6.5 | 22.50 |
| San Francisco, Cal. | 10.00 | 4.0 | 4.5 | 18.50 |
| Portland, Ore. | 10.50 | 4.0 | 6.5 | 21.00 |
| Spokane, Wash. | 12.50 | 4.0 | 6.5 | 23.00 |

° Includes City Tax of 1.00
°° Includes City Tax of 0.50

## Pennsylvania Oils Other Than Lubes At Refineries

*(Compiled by National Petroleum Assn. from reports of oil region refiners. Figures in barrels.)*

| | April, 1945 | March, 1945 |
|---|---|---|
| Naphthas & Gasoline | | |
| (a) Straight run unblended and/or unleaded for sale as motor fuel | 2,611 | 2,707 |
| (b) Naphtha and gasoline for sale for blending or further refining, or held at refinery for further distillation, reforming blending or leading | 272,253 | 263,040 |
| (c) Below 65 octane not included in (a) or (b) above | 4,643 | 10,151 |
| (d) 65 octane and above | 230,496 | 287,863 |
| Salable naphthas other than motor fuel material (Does not include refinery process naphthas) | 17,463 | 20,327 |
| Kerosine | 59,529 | 44,648 |
| 36/40 gas oil (includes furnace oil) | 37,620 | 35,022 |
| Fuel oil (not reported above) | 28,510 | 34,810 |
| Oils held as cracking plant charging stocks | 336,252 | 331,770 |
| Non-viscous neutral | 29,668 | 29,078 |
| Wax distillate | 84,283 | 90,616 |
| Crude petrolatum | 28,433 | 37,002 |
| Wax (lbs.) | 3,409,197 | 3,818,191 |

## Net Stocks Of Pennsylvania Crude Oil

*(Compiled by National Petroleum Assn. Figures in bbls.)*

| | April 30, 1945 | March 31, 1945 | April 30, 1944 |
|---|---|---|---|
| At Refineries | 296,230 | 297,500 | 287,497 |
| Pipeline and Tank Farm | 1,370,312 | 1,464,602 | 1,626,212 |

# REFINERY OPERATIONS

*(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)*

| Districts | Daily Average Crude Runs to Stills Week Ended | | Gasoline Production at Refineries inc. Natural Blended Week Ended | | Kerosine Production Week Ended | | Gas Oil & Dist. Fuel Oil Production Week Ended | | Res'dual Fuel Oil Production Week Ended | | Total Stocks Kerosine Week Ended | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | June 23 | June 16 | June 23 | June 16 | June 23 | June 16 | June 23 | June 16 | June 23 | June 16 | June 23 | June 16 |
| East Coast | 739 | 735 | 1,793 | 1,742 | 162 | 159 | 1,056 | 1,167 | 1,559 | 1,419 | 2,843 | 2,747 |
| Appalachian (Dist. 1) | 110 | 104 | 334 | 337 | 55 | 60 | 89 | 107 | 91 | 114 | 255 | 248 |
| Appalachian (Dist. 2) | 60 | 55 | 169 | 174 | 7 | 11 | 41 | 49 | 102 | 112 | 46 | 53 |
| Ind., Ill., Ky | 751 | 719 | 2,660 | 2,625 | 214 | 202 | 724 | 645 | 946 | 944 | 1,525 | 1,403 |
| Okla., Kans., Mo. | 398 | 395 | 1,477 | 1,465 | 160 | 183 | 487 | 460 | 496 | 477 | 725 | 697 |
| Inland Texas | 233 | 236 | 949 | 952 | 87 | 86 | 116 | 130 | 445 | 476 | 238 | 229 |
| Texas Gulf Coast | 1,253 | 1,190 | 2,763 | 3,993 | 370 | 482 | 1,394 | 1,532 | 1,809 | 1,709 | 1,487 | 1,540 |
| Louisiana Gulf Coast | 272 | 271 | 888 | 882 | 230 | 255 | 281 | 337 | 354 | 326 | 1,130 | 1,049 |
| No. La. & Arkansas | 84 | 84 | 248 | 240 | 51 | 54 | 64 | 79 | 133 | 119 | 300 | 164 |
| Rocky Mt. (Dist. 3) | 13 | 12 | 41 | 38 | 5 | 4 | 7 | 7 | 24 | 24 | 20 | 20 |
| Rocky Mt. (Dist. 4) | 119 | 127 | 422 | 384 | 22 | 18 | 93 | 93 | 217 | 245 | 105 | 124 |
| California | 986 | 987 | 2,623 | 2,300 | 156 | 66 | 662 | 736 | 3,433 | 3,288 | 489 | 438 |
| Total U.S.—B. of M. Basis | 5,018 | 4,915 | 15,367 | 15,132 | 1,519 | 1,580 | 5,014 | 5,342 | 9,609 | 9,252 | 9,163 | 8,512 |
| U. S.—B. of M. Basis, June 24, 1944 | 4,634 | | 13,937 | | 1,313 | | 4,361 | | 8,759 | | 9,308 | |

| Districts | Total Stocks Gas Oil and Distillates Week Ended | | Total Stocks Residual Fuel Oil Week Ended | | Gasoline Stocks—*Military and Other** Week Ended | | Gasoline Stocks—Civilian Grade Week Ended | |
|---|---|---|---|---|---|---|---|---|
| | June 23 | June 16 | June 23 | June 16 | June 23 | June 16 | June 23 | June 16 |
| East Coast | 7,259 | 6,928 | 5,908 | 5,966 | 5,494 | 5,050 | 8,416 | 8,308 |
| Appalachian (Dist. 1) | 605 | 440 | 256 | 236 | 1,546 | 1,684 | 1,223 | 1,227 |
| Appalachian (Dist. 2) | 506 | 88 | 63 | 86 | 122 | 508 | 907 | 892 |
| Ind., Ill., Ky. | 4,322 | 4,029 | 2,115 | 2,170 | 6,777 | 6,925 | 12,948 | 13,211 |
| Okla., Kans., Mo. | 1,792 | 1,669 | 1,236 | 1,198 | 2,243 | 2,275 | 7,381 | 7,221 |
| Inland Texas | 412 | 485 | 910 | 902 | 1,317 | 1,286 | 1,597 | 1,628 |
| Texas Gulf Coast | 5,471 | 4,960 | 5,729 | 5,362 | 9,277 | 9,804 | 5,141 | 4,545 |
| Louisiana Gulf Coast | 1,576 | 1,665 | 1,178 | 1,103 | 2,065 | 2,330 | 2,001 | 2,108 |
| N. La. & Arkansas | 646 | 1,455 | 183 | 191 | 924 | 162 | 1,542 | 1,753 |
| Rocky Mt. (Dist. 3) | 21 | 21 | 34 | 32 | 10 | 10 | 76 | 72 |
| Rocky Mt. (Dist. 4) | 317 | 301 | 534 | 563 | 693 | 690 | 1,689 | 1,699 |
| California | 8,834 | 8,356 | 21,747 | 21,673 | 10,385 | 10,410 | 3,688 | 3,706 |
| Total U. S. B. of M. Basis | 31,761 | 30,397 | 39,893 | 39,482 | 40,853 | 41,134 | 46,609 | 46,370 |
| U. S.—B. of M. Basis June 24, 1944 | 34,240 | | 53,349 | | 37,944 | | 46,753 | |

*Includes aviation and military grades, finished and unfinished, title to which still remains in the name of the producing company; solvents, naphthas, blending stocks currently indeterminate as to ultimate use, and 11,922,000 bbl. unfinished gasoline this week, compared with 11,971,000 bbl. a year ago.

**These figures do not include any gasoline on which title has already passed, or which the military forces may actually have in custody in their own or leased storage.

Percent Daily Refining Capacity Reporting—East Coast, 99.5; Appalachian (Dist. 1) 76.8, (Dist. 2) 81.2; Ind., Ill., Ky., 87.2; Okla., Kans., Mo., 78.3; Inland Texas, 59.8; Texas Gulf Coast, 89.3; Louisiana Gulf Coast, 96.8; No. Louisiana & Arkansas, 55.9; Rocky Mt. (Dist. 3) 17.1; (Dist. 4) 72.1; California, 85.8; Total U. S.—B. of M. Basis June 23, 1945 85.6; Total—B. of M. Basis June 16, 1945 85.6.

## U. S. CRUDE OIL PRODUCTION

(American Petroleum Institute figures)

| | WEEK ENDED Barrels (Daily Average) June 23, 1945 | Barrels (Daily Average) June 16, 1945 |
|---|---|---|
| Oklahoma | *384,300 | 386,350 |
| Kansas | *276,500 | 275,150 |
| Nebraska | * 900 | 900 |
| Texas | 2,180,450 | 2,180,450 |
| Louisiana | 368,150 | 368,000 |
| Arkansas | 79,650 | 78,700 |
| Mississippi | 50,600 | 52,000 |
| Alabama | 700 | 700 |
| Florida | 14 | 14 |
| Illinois | 204,400 | 200,250 |
| Indiana | 12,900 | 11,800 |
| Eastern (Ill., Ind. & Ky. excluded) | 65,850 | 64,750 |
| Kentucky | 30,600 | 29,600 |
| Michigan | 46,550 | 49,450 |
| Wyoming | 110,300 | 107,850 |
| Montana | 20,250 | 20,300 |
| Colorado | 11,250 | 11,550 |
| New Mexico | 103,800 | 103,750 |
| California | 950,700 | 946,800 |
| Total, U. S. | 4,897,864 | 4,888,364 |

*Okla. Kans. Neb. figures are for week ended 7:00 a.m. June 21, 1945.

## Crude Oil Stocks

*(Bureau of Mines Figures in thousands of bbls.)*

| Grade or Origin | June 16 | June 23 | Change from June 16 |
|---|---|---|---|
| Penna. Grade | 2,204 | 2,162 | — 42 |
| Other Appalachian | 1,389 | 1,347 | — 42 |
| Lima-Michigan | 934 | 939 | + 5 |
| Illinois-Indiana | 12,569 | 12,789 | +220 |
| Arkansas | 2,781 | 2,711 | — 70 |
| Kansas | 9,011 | 9,145 | + 44 |
| Louisiana: | 14,359 | 13,907 | —452 |
| Northern | 3,677 | 3,546 | —131 |
| Gulf Coast | 10,682 | 10,361 | —321 |
| Mississippi | 1,215 | 1,254 | + 39 |
| New Mexico | 5,829 | 5,911 | + 82 |
| Oklahoma | 30,924 | 31,086 | +162 |
| Texas: | 110,953 | 110,785 | —168 |
| East Texas | 18,169 | 18,070 | — 99 |
| West Texas | 31,806 | 32,075 | +269 |
| Gulf Texas | 31,789 | 31,312 | —477 |
| Other Texas | 29,189 | 29,328 | +139 |
| Panhandle | 5,071 | 4,938 | —133 |
| North | 7,955 | 7,875 | — 80 |
| South | 7,153 | 7,402 | +249 |
| Other | 9,010 | 9,113 | +103 |
| Rocky Mountain | 6,737 | 6,845 | +108 |
| California | 19,085 | 18,846 | —239 |
| Foreign | 3,852 | 3,247 | —605 |
| Total gasoline-bearing in U. S. | 221,932 | 220,974 | —958 |
| Heavy in California | 5,295 | 5,234 | — 61 |

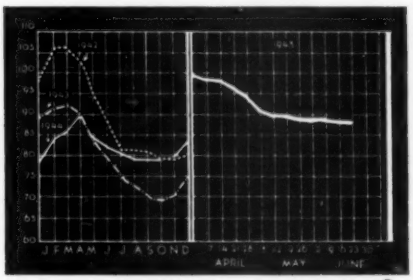
## Crude Production & Runs to Stills

*(Millions of Barrels)*

Crude Output
Runs to Stills
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D 7 14 21 28 5 12 19 26 2 9 16 23 30
1942
1943
1944
APRIL
MAY
JUNE

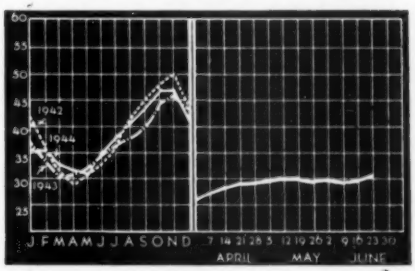
## Gasoline Stocks

*(Millions of Barrels)*



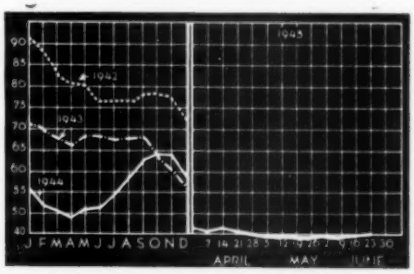

## Gas Oil & Distillate Stocks

*(Millions of Barrels)*



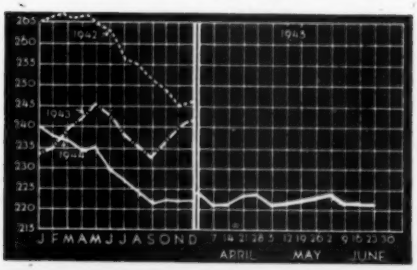

## Residual Fuel Oil Stocks

*(Millions of Barrels)*




## Crude Oil Stocks

*(Millions of Barrels)*



# OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

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## Refinery Prices

**Gasoline** —U. S. Motor (A S T M) except where otherwise specified.

| Prices in Effect | July 2 | June 25 |
|---|---|---|
| **OKLAHOMA** | | |
| 76 oct. Ethyl... | 6.75 | 6.75 |
| 70-74 oct..... | 5.875 | 5.875 |
| 63-66 oct..... | 5.625 (1) | 5.625 (1) |
| 60 oct. & below. | 5.25 | 5.25 |
| **MID-WESTERN** (Group 3 basis) | | |
| 76 oct. Ethyl... | 6.75 | 6.75 |
| 70-74 oct..... | 5.875 | 5.875 |
| 63-66 oct..... | 5.625 (2) | 5.625 (2) |
| 60 oct. & below. | 5.2 - 5.25 | 5.2 - 5.25 |
| **N. TEX.** (For shpt. to Tex. & N. M. dest'ns.) | | |
| 76 oct. Ethyl... | 7 | 7 |
| 70-74 oct..... | 5.875 | 5.875 |
| 63-66 oct..... | 5.625 (1) | 5.625 (1) |
| 60 oct. & below. | 5.2 - 5.25 | 5.2 - 5.25 |
| **W. TEX.** (For shpt. to Tex. & N. M. dest'ns.) | | |
| 76 oct. Ethyl... | 7 (2) | 7 (2) |
| 70-74 oct..... | 5.875 | 5.875 |
| 63-66 oct..... | 5.625 (1) | 5.625 (1) |
| 60 oct. & below. | 5.25 | 5.25 |
| **CENT. W. TEX.** (Prices to truck transports) | | |
| 76 oct..... | 6.875-7 (2) | 6.875-7 (2) |
| 70-74 oct..... | 5.875 (2) | 5.875 (2) |
| 67-69 oct..... | .... | .... |
| 62 oct. & below. | 5.25 (2) | 5.25 (2) |
| **KANSAS** (For Kansas destinations only) | | |
| 76 oct. Ethyl... | 7.2 - 7.3 | 7.2 - 7.3 |
| 70-74 oct..... | 6.2 | 6.2 |
| 63-66 oct..... | 5.9 (2) | 5.9 (2) |
| 60 oct. & below. | 5.5 | 5.5 |
| **ARK.** (For shipment to Ark. & La.) | | |
| 76 oct. Ethyl... | 7 (1) | 7 (1) |
| 70-74 oct..... | 5.875 (1) | 5.875 (1) |
| 62 oct. " | .... | .... |
| 60 oct. & below, unleaded..... | 5.25 (1) | 5.25 (1) |
| **WESTERN PENNA.** (Motor gasoline) | | |
| *Bradford-Warren*: | | |
| "Q" Gasoline Min. 70 Oct. (ASTM) | 7.625-8.225(a) | 7.625-8.225(a) |
| *Other districts*: "Q" Gasoline, Min. 70 Oct. (ASTM) | 7.725 | 7.725 |

(a) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

| Prices in Effect | July 2 | June 25 |
|---|---|---|
| **CENTRAL MICHIGAN** (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.) U.S. Motor: (Oct. ASTM): | | |
| 70-74 oct..... | 7.875- 8.375 | 7.875- 8.375 |
| 75-76 oct..... | 9 (1) | 9 (1) |
| Str. run gasoline, excluding Detroit shpt..... | 6 | 6 |
| **OHIO** (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances). | | |
| 70-74 oct..... | 8.25 | 8.25 |
| **CALIFORNIA** U.S. Motor: | | |
| 76 oct. (Ethyl)... | 8 - 8.75 | 8 - 8.75 |
| 70-74 oct..... | 7 - 7.5 | 7 - 7.5 |
| 65 oct. & below (3rd grade)..... | 5.75 - 6.25 | 5.75 - 6.25 |

## Kerosine, & Gas Fuel Oils

| | | |
|---|---|---|
| **OKLAHOMA** | | |
| 41-43 grav. w.w... | 4.375 | 4.375 |
| 42-44 grav. w.w... | 4.5 | 4.5 |
| Range oil..... | 4 | 4 |
| No. 1 p.w..... | 3.875 | 3.875 |
| No. 1 straw..... | .... | .... |
| No. 2 straw..... | 3.625 | 3.625 |
| No. 3 fuel..... | 3.5 | 3.5 |
| No. 6 fuel..... | $0 90-$0.97 | $0.90-$0.97 |
| U. G. I. Gas Oil.. | .... | .... |
| 14-16 fuel..... | $0.97 (1) | $0.97 (1) |
| **MID-WESTERN** (Group 3 basis) | | |
| 41-43 grav. w.w... | 4.375 | 4.375 |
| 42-44 grav. w.w... | 4.5 | 4.5 |
| Range Oil..... | 4 -4.1 (2) | 4 -4.1 (2) |
| No. 1 p.w..... | 3.875 | 3.875 |
| No. 2 straw..... | 3.625 | 3.625 |
| No. 3..... | .... | .... |
| No. 5..... | .... | .... |
| No. 6..... | $0.97 (1) | $0.97 (1) |
| **N. TEX.** (For shpt. to Tex. & N. M. dest'ns.) | | |
| 41-43 grav. w.w... | 4.375 | 4.375 |
| 42-44 grav. w.w... | 4.5 (1) | 4.5 (1) |
| No. 1 p.w..... | 3.875 (1) | 3.875 (1) |
| No. 6 fuel..... | $0.97 (1) | $0.97 (1) |
| **W. TEX.** No. 6 fuel..... | $0.97 (1) | $0.97 (1) |
| **AMARILLO, TEX.** (For shpt. to W. Okla. & Tex. differential territory.) | | |
| 42-44 grav. w.w... | 4.5 (1) | 4.5 (1) |
| **KANSAS** (For Kansas destinations only). | | |
| 41-43 grav. w.w... | No Price | No Price |
| 42-44 grav. w.w... | 4.7 | 4.7 |
| No. 1 p.w..... | 4.1 | 4.1 |
| No. 6 fuel..... | $0.95-$1.02 | $0.95-$1.02 |
| **ARK.** (For shipment to Ark. and La.) | | |
| 41-43 grav. w.w... | .... | .... |
| 42-44 w.w. kero... | 4.5 (1) | 4.5 (1) |
| No. 1..... | .... | .... |
| No. 2..... | 3.625 (1) | 3.625 (1) |
| No. 3 fuel..... | 3.5 (1) | 3.5 (1) |
| Tractor fuel, for shpt. to Ark. points only.... | 5.125 (1) | 5.125 (1) |
| Diesel fuel 52 & below..... | 4 (1) | 4 (1) |
| Diesel fuel 58 & above..... | 4.25 (1) | 4.25 (1) |
| **WESTERN PENNA.** | | |
| *Bradford-Warren*: | | |
| 45 grav. w.w..... | 6.5 - 7.55 | 6.5 - 7.55 |
| 46 grav. w.w..... | .... | .... |
| No. 1 fuel..... | 6.75(1&b) | 6.75(1&b) |
| No. 2 " ... | 6.125-7.125(2&b) | 6.125-7.125(2&b) |
| No. 3 " .... | 6.25-7.25(1&b) | 6.25-7.25(1&b) |
| 36-40 gravity..... | 6.625-6.75(2) | 6.625-6.75(2) |

(b) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

| | | |
|---|---|---|
| *Other districts*: | | |
| 45 grav. w.w..... | 7 - 7.425 | 7 - 7.425 |
| 46 grav. w.w..... | 7.125- 7.375 | 7.125- 7.375 |
| 47 grav. w.w..... | 7.375- 7.50 | 7.375- 7.50 |
| No. 1 fuel..... | 6.875- 7.175 | 6.875- 7.175 |
| No. 2 " ..... | 6.75 - 6.875 | 6.75 - 6.875 |
| No. 3 " ..... | 6.75 | 6.75 |
| 36-40 grav. Pittsburgh dist. prices excluded..... | 6.625- 6.875 | 6.625- 6.875 |
| **CENTRAL MICHIGAN** (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.) | | |
| 46-49 gravity w.w. | 5.8 - 6 | 5.8 - 6 |
| P.W. Distillate... | 5.5 | 5.5 |
| No. 3 gas. oil, Straw | 5 | 5 |
| U.G.I. gas oil..... | 4.5 (2) | 4.5 (2) |
| **Fuel Oils** (*Vis. at* 100). | | |
| 300-500 Vis..... | 4.14 (2) | 4.14 (2) |
| 100-300 Vis..... | 4.5 | 4.5 |
| **OHIO** (S. O. quotations for statewide delivery) Kerosine..... | 7 | 7 |

| Prices in Effect | July 2 | June 25 |
|---|---|---|
| **CALIFORNIA** | | |
| 40-43 grav. w.w... | 5 - 7 | 5 - 7 |
| *San Joaquin Valley*: | | |
| Heavy fuel..... | $1.10 (2) | $1.10 (2) |
| Light fuel..... | $1.20 (2) | $1.20 (2) |
| Diesel fuel..... | 4 (2) | 4 (2) |
| Stove dist..... | 5 (2) | 5 (2) |
| *Los Angeles*: | | |
| Heavy fuel..... | $1.10 (2) | $1.10 (2) |
| Light fuel..... | $1.20 (2) | $1.20 (2) |
| Diesel fuel..... | 4 (2) | 4 (2) |
| Stove dist..... | 5 (1) | 5 (1) |
| *San Francisco*: | | |
| Heavy fuel..... | $1.15 (1) | $1.15 (1) |
| Light fuel..... | $1.25 (1) | $1.25 (1) |
| Diesel fuel..... | 4.5 (1) | 4.5 (1) |
| Stove dist..... | 5.5 (1) | 5.5 (1) |

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

## Lubricating Oils

| Prices in Effect | July 2 | June 25 |
|---|---|---|
| **WESTERN PENNA.** Prices are for sales made, or offers reliably reported, to jobbers & compounders only. Viscous Neutrals—*No. 3 col Vis. at* 70°*F.* | | |
| 200 Vis. (180 at 100°) 420-425 fl. | | |
| 0 p.t..... | 38 (1) | 38 (1) |
| 10 p.t..... | 37 (1) | 37 (1) |
| 15 p.t..... | 36 (1) | 36 (1) |
| 25 p.t..... | 28-33 | 28-33 |
| 150 Vis. (143 at 100°) 400-405 fl. | | |
| 0 p.t..... | 36 (1) | 36 (1) |
| 10 p.t..... | 35 (1) | 35 (1) |
| 15 p.t..... | 34 (1) | 34 (1) |
| 25 p.t..... | 26-31 | 26-31 |

NOTE: Limited quantity neutrals available to regular trade.

| | | |
|---|---|---|
| **Cylinder Stocks:** | | |
| *Brt. stk.*, 145-155 *vis. at* 210°, 540-550 fl., *No. 3 col.* | | |
| 10 p.t..... | 30.5 (1) | 30.5 (1) |
| 15 p.t..... | 29.5 (1) | 29.5 (1) |
| 25 p.t..... | 25 | 25 |
| 600 S.R. filterable | 15 | 15 |
| 650 S.R..... | 15.5 | 15.5 |
| 600 fl..... | 16 | 16 |
| 630 fl..... | 17 | 17 |

**MID-CONTINENT** (F. o. b. Tulsa)

Neutral Oils (*Vis. at* 100° *F. 0 to* 10 *P.P.*)

**Pale Oils:**

| Vis. Color | | |
|---|---|---|
| 60-85—No. 2.... | 7.5 | 7.5 |
| 86-110—No. 2... | 7.5 - 8.5 | 7.5 - 8.5 |
| 150—No. 3..... | 11 -11.5 | 11 -11.5 |
| 180—No. 3..... | 11.5 -15 | 11.5 -15 |
| 200—No. 3..... | 12 -15 | 12 -15 |
| 250—No. 3..... | 14 -16.5 | 14 -16.5 |
| 280—No. 3..... | 15 -17 | 15 -17 |
| 300—No. 3..... | 16 -18 | 16 -18 |
| **Red Oils:** | | |
| 180—No. 5..... | 11.5 (1) | 11.5 (1) |
| 200—No. 5..... | 12 (1) | 12 (1) |
| 280—No. 5..... | No Price | No Price |
| 300—No. 5..... | 16-17.5 (2) | 16-17.5 (2) |
| **Bright Stock**—*Vis. at* 210° | | |
| 200 Vis. D..... | 27 (1) | 27 (1) |
| 150-160 Vis. D: 0 to 10 p.p.... | 23 | 23 |
| 10 to 25 p.p.... | 22.5-23 | 22.5-23 |
| 25 to 40 p.p.... | 23 (1) | 23 (1) |
| 150-160 Vis. E.... | 22 (1) | 22 (1) |
| 120 Vis. D: 0 to 10 p.p.... | 22 (2) | 22 (2) |
| 600 S.R. Dark Green..... | 8.5 (1) | 8.5 (1) |
| 600 S.R. Olive Green..... | 10-11 (2) | 10-11 (2) |
| 631 S.R..... | .... | .... |
| Black Oil..... | .... | .... |

NOTE: Discounts of 0.5c to 1c on bright stock and 0.5c to 2c allowed for neutrals, 10 car lots, and to "meet competition." Brokers offering at greater discounts.

**SOUTH TEXAS** (Neutral Oils)

**Pale Oils** (*Vis. at* 100°*F.*)

| Vis. Color | | |
|---|---|---|
| 100 No. 1½-2½. | 6.5 | 6.5 |
| 200 No. 2-3..... | 8.75 | 8.75 |
| 300 No. 2-3..... | 9.25 | 9.25 |
| 500 No. 2½-3½. | 10 | 10 |
| 750 No. 3-4..... | 10.25 | 10.25 |
| 1200 No. 3-4..... | 10.375 | 10.375 |
| 2000 No. 4..... | 10.5 | 10.5 |

(Continued on next page)

**NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.**

***NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.***

## Refinery Prices (Continued)

| Prices in Effect | July 2 | June 25 |
|---|---|---|
| **Red Oils:** | | |
| 100 No. 5-6 | 6.5 (2) | 6.5 (2) |
| 200 No. 5-6 | 8.75 | 8.75 |
| 300 No. 5-6 | 9.25 | 9.25 |
| 500 No. 5-6 | 10 | 10 |
| 750 No. 5-6 | 10.25 | 10.25 |
| 1200 No. 5-6 | 10.375 | 10.375 |
| 2000 No. 5.6 | 10.5 | 10.5 |

**CHICAGO** (From Mid-Continent p.l. crude.) Neutral oils *vis. at* 100° *F. 0 to* 10 *p.p.*

| **Pale Oils** via. Color | | |
|---|---|---|
| 60-85—No. 2 | 9 (1) | 9 (1) |
| 86-110—No. 2 | 9.25 (1) | 9.25 (1) |
| 150—No. 3 | 12.5 (1) | 12.5 (1) |
| 180—No. 3 | 13 (1) | 13 (1) |
| 200—No. 3 | 13 (1) | 13 (1) |
| 250—No. 3 | 14 (1) | 14 (1) |
| **Red Oils:** | | |
| 180—No. 5 | 13 (1) | 13 (1) |
| 200—No. 5 | 13 (1) | 13 (1) |
| 250—No. 5 | 14 (1) | 14 (1) |
| 280—No. 5 | 15 (1) | 15 (1) |
| 300—No. 5 | 15.5 (1) | 15.5 (1) |

**Note:** Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

| **Unfiltered Steam Refined** (*Viscosity at* 210°) | | |
|---|---|---|
| 140 | 11.5 (1) | 11.5 (1) |
| 160 | 12.5 (1) | 12.5 (1) |
| 200 | 13.5 (1) | 13.5 (1) |

| **Bright stocks,** 160 *vis. at* 210 *No.* 8 *color:* | | |
|---|---|---|
| 0 to 10 p.p. | 24 (1) | 24 (1) |
| 15 to 25 p.p. | 23.5 (1) | 23.5 (1) |
| 30 to 40 p.p. | 21.5 (1) | 21.5 (1) |
| E filtered Cyl. Stock | 15.5 (1) | 15.5 (1) |

**Note:** To obtain prices delivered in Chicago add 0.25c per gal.

## Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

| | | |
|---|---|---|
| **FOB GROUP 3** | | |
| Grade 26-70 | 4.5 (Quotes) | 4.5 (Quotes) |
| **FOB BRECKENRIDGE** | | |
| Grade 26-70 | 4.125 (Quotes) | 4.125(Quotes) |
| **CALIFORNIA** (FOB plants in Los Angeles basin) | | |
| 21 pound vapor pressure for blending | 4.75 - 5.375 | 4.75 - 5.375 |

## Naphtha and Solvent

| (*FOB Group* 3) | | |
|---|---|---|
| Stoddard solvent | 6.625 | 6.625 |
| Cleaners' naphtha | 7.125 | 7.125 |
| V.M.&P. naphtha | 7.1 - 7.125 | 7.1 - 7.125 |
| Mineral spirits | 6.1 - 6.125 | 6.1 - 6.125 |
| Rubber solvent | 7.1 - 7.125 | 7.1 - 7.125 |
| Lacquer diluent | 7.375- 8.125 | 7.375- 8.125 |
| Benzol Diluent | 7.875-8.625 | 7.875- 8.625 |

**WESTERN PENNA.**

| *Other Districts:* | | |
|---|---|---|
| Untreated naphtha | 7 -7.25 (2) | 7 -7.25 (2) |
| Stoddard solvent | 7.25 -7.5 | 7.25 -7.5 |

**OHIO** (S. O. quotations for statewide delivery:)

| V.M.&P. naphtha. | D.C. naphtha, | Varnolene & |
|---|---|---|
| Sohio solvent | 10 | 10 |
| Rubber solvent | 9 | 9 |

## Wax

**WESTERN PENNA.** (Bbls. C.L.) White Crude Scale:

| | | |
|---|---|---|
| 122-124 A.m.p. | 4.25 (2) | 4.25 (2) |
| 124-126 A.m.p. | 4.25 | 4.25 |

**OKLAHOMA** (C.L. FOB Refinery)

| Semi-refined: | | |
|---|---|---|
| 128 AMP min., white, 50 kilo bags | No Price | No Price |
| 132-134 AMP, bbls. | 5.25 (1) | 5.25 (1) |

**CHICAGO** (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose, 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

| Fully refined: | | |
|---|---|---|
| 122-124 (bags only) | 5.6 | 5.6 |
| 125-127 | 6 | 6 |
| 127-129 | 6.25 | 6.25 |
| 130-132 | 6.55 | 6.55 |
| 133-134 | 6.8 | 6.8 |
| 135-137 | 7.55 | 7.55 |

## Petrolatums

**WESTERN PENNA.** (Bbls., carloads: tank cars, 0.5c per lb. less.)

| | | |
|---|---|---|
| Snow White | 6.125- 7.25 | 6.125- 7.25 |
| Lily White | 5.375- 6.25 | 5.375- 6.25 |
| Cream White | 4.375- 5.5 | 4.375- 5.5 |
| Light Amber | 3.375- 4 | 3.375- 4 |
| Amber | 3.125- 3.75 | 3.125- 3.75 |
| Red | 3 - 3.5 | 3 - 3.5 |

## Tank Wagon Prices

*Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline* **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect July 2, 1945 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

**S. O. N. J.**

| | Esso (*Regular Grade*) Consumer Tank Wagon | Dealer T.W. | Gasoline Taxes | Kerosine T.W. |
|---|---|---|---|---|
| *Atlantic City, N. J. | 10.2 | 10.7 | 4.5 | 10.00 |
| *Newark | 10.2 | 10.7 | 4.5 | 10.00 |
| Annapolis, Md. | 10.55 | 11.05 | 5.5 | ..... |
| Baltimore | 9.95 | 10.45 | 5.5 | 10.8 |
| Cumberland | 11.35 | 11.85 | 5.5 | 12.3 |
| Washington, D. C. | 10.20 | 10.7 | 4.5 | 11.3 |
| Danville, Va | 11.65 | 12.15 | 6.5 | 11.55 |
| Petersburg | 10.75 | 11.25 | 6.5 | 12.3 |
| Norfolk | 10.45 | 10.95 | 6.5 | 11.3 |
| Richmond | 10.75 | 11.25 | 6.5 | 12.3 |
| Roanoke | 11.95 | 12.45 | 6.5 | 11.8 |
| Charleston, W. Va. | 11.65 | 12.15 | 6.5 | 13.1 |
| Parkersburg | 10.95 | 11.45 | 6.5 | 12.8 |
| Wheeling | 10.95 | 11.45 | 6.5 | 13.4 |
| Charlotte, N. C. | 11.7 | 12.20 | 7.5 | 11.3 |
| Hickory | 12.25 | 12.75 | 7.5 | 12.3 |
| Mt. Airy | 12.1 | 12.6 | 7.5 | 11.5 |
| Raleigh | 11.45 | 11.95 | 7.5 | 12.3 |
| Salisbury | 11.75 | 12.25 | 7.5 | 12.7 |
| Charleston, S. C. | 10.55 | 11.05 | 7.5 | ..... |
| Columbia | 11.4 | 11.9 | 7.5 | ..... |
| Spartanburg | 12.1 | 12.6 | 7.5 | ..... |
| New Orleans, La. | 8.75 | 9.25 | 8.5 | **8.00 |
| Baton Rouge | 8.75 | 9.25 | 8.5 | **8.5 |
| Alexandria | 8.75 | 9.25 | 8.5 | **8.5 |
| Lake Charles | 9.00 | 9.5 | 8.5 | **10.00 |
| Shreveport | 8.5 | 9.00 | 8.5 | **7.00 |
| Knoxville, Tenn. | 10.5 | 11.00 | 8.5 | 10.5 |
| Memphis | 8.9 | 9.4 | 8.5 | 8.5 |
| Chattanooga | 10.5 | 11.00 | 8.5 | 9.00 |
| Nashville | 10.5 | 11.00 | 8.5 | 8.00 |
| Bristol | 9.75 | 10.25 | 8.5 | 10.0 |
| Little Rock, Ark. | 9.5 | 10.00 | 8.0 | 10.00 |
| Lafayette, La. | 9.0 | 9.50 | 8.5 | 10.00 |

| | Mineral Spirits T.W. | V.M.&P. T.W. |
|---|---|---|
| Newark, N. J. | 13 | 14.5 |
| Baltimore, Md. | 15.5 | .... |
| Washington, D. C. | 15.5 | .... |

| Fuel Oils—T.W. | No. 1 | No. 2 | No. 3 |
|---|---|---|---|
| Atlantic City, N. J. | 10 | 9 | 9 |
| Newark | 10 | 9 | 9 |
| Annapolis, Md. | .. | .. | .. |
| Baltimore | 9.8 | 9 | 9 |
| Washington, D. C. | 10.3 | 9.4 | 9.4 |
| Norfolk, Va. | 10 | 8.8 | 8.8 |
| Petersburg | 10.3 | 9 | .. |
| Richmond | 10.3 | 9 | 9 |
| Charlotte, N. C. | 10.3 | 10.1 | .. |
| Hickory, N. C. | .. | 9.7 | .. |
| Raleigh | 11.3 | 9.8 | .. |
| Charleston, S. C. | .. | 8.7 | .. |
| Columbia | .. | 9.7 | .. |
| Spartanburg | .. | 10.5 | .. |

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.

Discounts:

**Includes 1.0c per gallon State Tax.

*Effective Nov. 7, 1944, the discount for kerosine in the State of Virginia was eliminated, the discount in Tennessee was eliminated May 1, 1945 and the discount in Louisiana was eliminated May 7, 1945.

Undivided Dealers at Dealer Tank Wagon price less 0.5c per gallon for Esso Gasoline.

*Esso gasoline*—to undivided dealers, 0.5c off dealer t.w.

*Kerosine*—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey, Virginia, Tennessee and Louisiana.

*Naphtha*—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

## Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline; Ark 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Miss. 1/50c; Neb. 3/100c; Nev. 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Ala. 1/2c; Fla. 1/8c; Iowa 3/50c; Mich. 1/5c per gal.

**CONT'L OIL**

| | Conoco Bronz-z-s (*3rd Grade*) †Tank Wagon | Demand | Gasoline Taxes | Kerosine T.W. |
|---|---|---|---|---|
| Denver, Col. | 10 | 9 | 5.5 | 10 |
| Grand Junc., Col. | 12.5 | 11.5 | 5.5 | 12.5 |
| Pueblo, Col. | 9.5 | 8.5 | 5.5 | 9.5 |
| Casper, Wyo. | 11.5 | 10.5 | 5.5 | 12 |
| Cheyenne, Wyo. | 10 | 9 | 5.5 | 9 |
| Billings, Mont. | 12 | 11 | 6.5 | 12.5 |
| Butte, Mont. | 11.5 | 10.5 | 6.5 | 13.5 |
| Great Falls, Mont. | 12 | 11 | 6.5 | 12.5 |
| Helena, Mont. | 12 | 11 | 6.5 | 12 |
| Salt Lake City, Utah | 13.5 | 12.5 | 5.5 | 14.5 |
| Twin Falls, Ida. | 14.5 | 13.5 | 7.5 | 14 |
| Albuquerque, N. M. | 10.5 | 9.5 | *7 | 9.5 |
| Roswell, N. M. | 10 | 9 | *7 | 7 |
| Santa Fe, N. M. | 10.5 | 9.5 | *7.5 | 10 |
| Ft. Smith, Ark. | 9 | 6.25 | 8 | 8 |
| Texarkana, Ark. | 9 | 7.5 | *5.5 | 7 |
| Muskogee, Okla. | 7.75 | 6.75 | 9 | 8 |
| Oklahoma City, Okla. | 8 | 7 | 9 | 8 |
| Tulsa, Okla. | 8 | 7 | 9 | 8 |

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.

†To consumers & Dealers.

NOTE: Current selling price—where this is lower than maximum price it is because of local competition. It is the actual selling price **and** is subject to revision due to delays in receiving information from the field

Arkansas tax 8c applies at Ft. Smith.

**S. O. CAL.**

Standard Gasoline (*Regular Grade*)
Flight Gasoline (*Third Grade*)

| | Standard Posted Net Tank Truck | Standard Posted Retail | Flight Posted Net Tank Truck | Flight Posted Retail | Gasoline Taxes |
|---|---|---|---|---|---|
| San Francisco, Cal. | 10 | 14 | 9 | 12 | 4.5 |
| Los Angeles, Cal. | 9.5 | 13.5 | 8.5 | 11.5 | 4.5 |
| Fresno, Cal. | 11 | 15 | 10 | 13 | 4.5 |
| Phoenix, Ariz. | 12 | 16 | 10 | 13 | 6.5 |
| Reno, Nev. | 12 | 16 | 11 | 14 | 5.5 |
| Portland, Ore. | 10.5 | 14.5 | 9.5 | 12.5 | 6.5 |
| Seattle, Wash. | 10.5 | 14.5 | 9.5 | 12.5 | 6.5 |
| Spokane, Wash. | 12.5 | 16.5 | 11.5 | 14.5 | 6.5 |
| Tacoma, Wash. | 10.5 | 14.5 | 9.5 | 12.5 | 6.5 |

*Chevron Aviation 73

| | Posted Net Tank Truck | Gasoline Taxes | Kerosine Tank Truck |
|---|---|---|---|
| San Francisco, Cal. | 12.5 | 4.5 | 11.5 |
| Los Angeles, Cal. | 12 | 4.5 | 10 |
| Fresno, Cal. | 13.5 | 4.5 | 12.5 |
| Phoenix, Ariz. | 14.5 | 6.5 | 12.5 |
| Reno, Nev. | 14.5 | 5.5 | 13.5 |
| Portland, Ore. | 13 | 6.5 | 13.8 |
| Seattle, Wash. | 13 | 6.5 | 13.8 |
| Spokane, Wash. | 16 | 6.5 | 16.8 |
| Tacoma, Wash. | 13 | 6.5 | 13.8 |

Resale and Commercial Gasoline: Tank car deliveries of Chevron Aviation 73, Standard's Supreme and Flight Gasoline .25c per gal. below posted net tank truck price. Tank car deliveries of Standard Gasoline .375c per gal. below posted net tank truck price. Pearl Oil (The Standard Kerosene) Tank car deliveries 3c below posted tank truck price.

*Formerly Standard Aviation 73.

**TEXAS CO.**

| | Gasoline—Dealer T.W. Fire-Chief (Regular) | Indian (*3rd Grade*) | Gasoline Taxes |
|---|---|---|---|
| Dallas, Tex. | 7.5 | 6.5 | 5.5 |
| Ft. Worth, Tex. | 7.5 | 6.5 | 5.5 |
| Wichita Falls, Tex. | 8.5 | 7.5 | 5.5 |
| Amarillo, Tex. | 8.5 | 7.5 | 5.5 |
| Tyler, Tex. | 8.5 | 7.5 | 5.5 |
| El Paso, Tex. | 11 | 10.5 | 5.5 |
| San Angelo, Tex. | 8.5 | 7.5 | 5.5 |
| Waco, Tex. | 8.5* | 7* | 5.5 |
| Austin, Tex. | 8.5 | 7.5 | 5.5 |
| Houston, Tex. | 8.5 | 7.5 | 5.5 |
| San Antonio, Tex. | 8.5 | 7.5 | 5.5 |
| Port Arthur, Tex. | 8.5 | 7.5 | 5.5 |

*Less 1c temporary allowance to all dealers.

(Continued on next page)

## Tank Wagon Prices—Continued

### S. O. IND.

Red Crown (Regular Grade) Blue Crown (Third Grade) Red Dealer Prices

| | Red Crown Cons. T.W. | Red Crown | Blue Crown | Gasoline Taxes | Kerosine T.W. |
|---|---|---|---|---|---|
| Chicago, Ill. | 11.6 | 9.6 | 9.1 | 4.5 | 10.6 |
| Decatur, Ill. | 11.6 | 9.6 | 8.7 | 4.5 | 10.3 |
| Joliet, Ill. | 11.9 | 10.3 | 9.2 | 4.5 | 10.6 |
| Peoria, Ill. | 11.7 | 9.9 | 9.7 | 4.5 | 10.4 |
| Indianapolis, Ind. | 11.6 | 10.1 | 9.6 | 5.5 | 10.1 |
| Evansville, Ind. | 11.4 | 9.9 | 8.6 | 5.5 | 9.9 |
| South Bend, Ind. | 12 | 10.5 | 10 | 5.5 | 10.5 |
| Detroit, Mich. | 11.4 | 9.9 | ... | 4.5 | 10 |
| Grand Rapids, Mich. | 11.4 | 9.9 | ... | 4.5 | 9.9 |
| Saginaw, Mich. | 11.4 | 9.9 | ... | 4.5 | 9.9 |
| Green Bay, Wis. | 12 2 | 10.7 | 10.2 | 5.5 | 10.9 |
| Milwaukee, Wis. | 12.1 | 10.6 | 10.1 | 5.5 | 10.8 |
| La Crosse, Wis. | 11.9 | 10.4 | 9.9 | 5.5 | 10.6 |
| Minneapolis - St. Paul. | 11.9 | 10.4 | 9.9 | 5.5 | 10.6 |
| Duluth, Minn. | 12.2 | 10 7 | .... | 5.5 | 10.9 |
| Mankato, Minn. | 11.9 | 10.4 | 9.9 | 5.5 | 10.6 |
| Des Moines, Ia. | 11.4 | 9.9 | 9.4 | 4.5 | *10.1 |
| Mason City, Ia. | 11.7 | 10.2 | 9.7 | 4.5 | *10.4 |
| St. Louis, Mo. | 11.0 | 9.5 | 9.3 | *4.5 | 10.1 |
| Kansas City, Mo. | 11.0 | 9.5 | 8.6 | *4.5 | 9.7 |
| St. Joseph, Mo. | 11.2 | 9.7 | 9.2 | *4.5 | 9.9 |
| Fargo, N. D. | 12.9 | 11.4 | 10.9 | 5.5 | 11.6 |
| Huron, S. D. | 12.3 | 10.8 | 10.3 | 5.5 | 11 |
| Wichita, Kans. | 10.3 | 8.8 | 7.2 | 4.5 | 9.0 |
| Omaha, Neb. | 11.4 | 9.6 | 9.4 | 6.5 | 10.1 |

| | Oleum Spirits | V.M.&P. Naphtha | Stanisol | *Taxes |
|---|---|---|---|---|
| (Prices are base prices before discounts) | | | | |
| Chicago | 13.5 | 13.8 | 12.8 | 4.5 |
| Detroit | 15.8 | 15 | 16.3 | 4.5 |
| K. C., Mo. | 13.3 | 14.3 | 13.8 | 1.5 |
| St. Louis, Mo. | 13.7 | 14.7 | 13.2 | 1.5 |
| Milwaukee | 14.4 | 15.4 | 14.9 | 5.5 |
| Minneap'lis | 14.2 | 15.2 | 13 5 | 5.5 |

| | Fuel Oils T.W. Chicago Standard Heater Oil | Stanolex Furnace Oil |
|---|---|---|
| 1-99 gals. | 9.3 | 8.8 |
| 100-149 gals. | 8.3 | 7.8 |
| 150 gals. & over | 7.8 | ... |
| 150-399 gals. | ... | 7.8 |
| 400 gals. & over | ... | 7.3 |

| | Stanolex Fuel A | Stanolex Fuel C |
|---|---|---|
| 1-749 gals. | 6.5 | 6 0 |
| 750 gals. & over | 5.75 | 5.25 |

**Stanolex Furnace Oil**

| Other Points | 1-99 gals. | 100 gals. & over |
|---|---|---|
| Indianapolis | 9.0 | 8.0 |
| Detroit | 8.7 | 7.7 |
| Milwaukee | 9.0 | 8.0 |
| Minneapolis | 9.1 | 8.1 |
| St. Louis | 8.4 | 7.4 |
| Kansas City | 8.1 | 7.1 |

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

### S. O. OHIO

*Sohio X-70 Gasoline (Regular Grade)

| | Consumer Cons. T.W. | **Retailers ‡S.S. | Gasoline Taxes | †Kerosine T.W. |
|---|---|---|---|---|
| Ohio, Statewide | 12 | 10 | 13.5 | 5.5 | 9.3 |
| Akron | 12 | 9.5 | 12.5 | 5.5 | 9.3 |
| Canton | 12 | 9.5 | 12.5 | 5.5 | 9.3 |
| Cincinnati | 12 | 9.5 | 12.5 | 5.5 | 9.3 |
| Cleveland | 12 | 9.5 | 12.5 | 5.5 | 9.3 |
| Columbus | 12 | 9.5 | 12.5 | 5.5 | 9.3 |
| Dayton | 12 | 9.5 | 12.5 | 5.5 | 9 3 |
| Lima | 12 | 9.5 | 12.5 | 5.5 | 9 3 |
| Mansfield | 12 | 9 5 | 12.5 | 5.5 | 9.3 |
| Marion | 12 | 9 0 | 12.0 | 5.5 | 9.3 |
| Portsmouth | 12 | 9 5 | 12.5 | 5.5 | 9.3 |
| Toledo | 12 | 9 5 | 12.5 | 5.5 | 9 3 |
| Youngstown | 12 | 9 5 | 12.5 | 5.5 | 9 3 |
| Zanesville | 12 | 9 5 | 12.5 | 5 5 | 9.3 |

**Aviation Gasoline—Statewide**

| | Consumer Gasoline T.W. | Taxes |
|---|---|---|
| Sohio Aviation Gasoline clear Spec. AN-F-22 | 14 5 | 5.5 |
| Esso Ethyl Aviation 73 Oct. | 15.5 | 5.5 |
| Esso Ethyl Aviation 80 Oct. | 16.5 | 5.5 |
| Esso Ethyl Aviation 91 Oct. | 17.5 | 5.5 |
| Esso Ethyl Aviation 100 Oct. | 24.5 | 5.5 |

| | Naphtha—T.W. Statewide | Lucas County |
|---|---|---|
| S. R. Solvent | 13.5 | 13.5 |
| D. C. Naphtha | 14.5 | 14.25 |
| V.M.&P. Naphtha | 14 5 | 14.25 |
| Varnolene | 14 5 | 14.25 |
| Sohio Solvent | 14 5 | 14.25 |

| Fuel Oils—T.W. | No. 1 | No. 2 | No. 3 | No. 4 |
|---|---|---|---|---|
| Ohio, Statewide | 8 3 | 8 3 | 7 8 | *7 55 |

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only. Full compartment hose dumps.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

### ATLANTIC REFINING

Atlantic White Flash (Regular Grade)

| | Commercial T.W. | Dealer T.W. | Gasoline Taxes | Kerosine T.W. |
|---|---|---|---|---|
| Philadelphia, Pa. | 10.2 | 10.7 | 5.5 | 12.25 |
| Pittsburgh | 10.1 | 10.6 | 5.5 | 12.1 |
| Allentown | 10.7 | 11.2 | 5.5 | 12.6 |
| Erie | 10.1 | 10.6 | 5.5 | 12.1 |
| Scranton | 10.7 | 11.2 | 5.5 | 12.6 |
| Altoona | 10.7 | 11.2 | 5.5 | 12.6 |
| Emporium | 10.1 | 10.6 | 5.5 | 12.1 |
| Indiana | 10.7 | 11.2 | 5.5 | 12.6 |
| Uniontown | 10.1 | 10.6 | 5.5 | 12.1 |
| Harrisburg | 10.7 | 11.2 | 5.5 | 12.6 |
| Williamsport | 10.7 | 11.2 | 5.5 | 12.6 |
| Dover, Del. | .... | 11.2 | 5.5 | 12.6 |
| Wilmington, Del. | .... | 10.7 | 5.5 | 12.1 |
| Boston, Mass. | .... | 10.9 | 4.5 | .... |
| Springfield, Mass. | .... | 11.8 | 4.5 | .... |
| Worcester, Mass. | .... | 11.5 | 4.5 | .... |
| Fall River, Mass. | .... | 11 | 4.5 | .... |
| Hartford, Conn. | .... | 11.6 | 4.5 | .... |
| New Haven, Conn. | .... | 11 | 4.5 | .... |
| Providence, R. I. | .... | 11 | 4.5 | .... |
| Atlantic City, N. J. | .... | 10.7 | 4.5 | 10 |
| Camden, N. J. | .... | 10.7 | 4.5 | 10 |
| Trenton, N. J. | .... | 10.7 | 4.5 | 10 |
| Annapolis, Md. | .... | 11.05 | 5.5 | 10.8 |
| Baltimore, Md. | .... | 10.45 | 5.5 | 9.8 |
| Hagerstown, Md. | .... | 11.55 | 5.5 | 10.3 |
| Richmond, Va. | .... | 11.25 | 6.5 | 12.3 |
| Wilmington, N. C. | .... | 11.15 | 7.5 | 11.6 |
| Brunswick, Ga. | .... | 10.1 | 7.5 | *10.6 |
| Jacksonville, Fla. | .... | 10.1 | 8.5 | 11.6 |

| | Mineral Spirits T.W.† | V.M.&P. T.W.† |
|---|---|---|
| Philadelphia, Pa. | 11 | 12.5 |
| Lancaster, Pa. | 12 | 13.5 |
| Pittsburgh, Pa. | 12.5 | 13.5 |

| Fuel Oils—T.W. | 1 | 2 | 3 | 5 | 6 |
|---|---|---|---|---|---|
| Phila., Pa. | 10.1* | 9 | 9 | 5.76 | 5.04 |
| Allentown, Pa. | 10.6 | 9.3 | 9.3 | .... | .... |
| Wilmington, Del. | 10.1 | 9 | 9 | .... | .... |
| Springfield, Mass. | .... | 9.4 | 9.4 | .... | .... |
| Worcester, Mass. | .... | 9.3 | 9.3 | .... | .... |
| Hartford, Conn. | .... | 9.2 | 9.2 | .... | .... |

*Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w. except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

### S. O. KY.

Crown Gasoline (Regular)

| | †Net Crown | Gasoline Taxes | Kerosine T.W. |
|---|---|---|---|
| Covington, Ky. | 9.5 | 6.5 | 9 |
| Lexington, Ky. | 10.5 | 6.5 | 9 |
| Louisville, Ky. | 10 | 6.5 | 8 |
| Paducah, Ky. | 10 | 6.5 | 8 |
| Jackson, Miss. | 10 | 7.5 | *9 |
| Vicksburg, Miss. | 9.5 | 7.5 | *8 |
| Birmingham, Ala. | 10 | *8.5 | 9 |
| Mobile, Ala. | 9 | *9.5 | 8 |
| Montgomery, Ala. | 10 | *9.5 | *10 |
| Atlanta, Ga. | 11.1 | 7.5 | *11 |
| Augusta, Ga. | 11.1 | 7.5 | *11 |
| Macon, Ga. | 11.1 | 7.5 | *11 |
| Savannah, Ga. | 10.1 | 7.5 | *10 |
| Jacksonville, Fla. | 10.1 | 8.5 | 9 |
| Miami, Fla. | 10.1 | 8.5 | 9 |
| Pensacola, Fla. | 9 | *9.5 | 8 |
| Tampa, Fla. | 10.1 | 8.5 | 9 |

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city, Montgomery, 1c city and 1 county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, included in above prices.

†Consumer t.w. prices are same as net dealer prices.

### HUMBLE OIL

Humble Motor Fuel (Regular Grade)

| | Thriftane Humble *Tank Wagon | Thriftane Humble Retail | Thriftane (Third Grade) *Tank Wagon | Thriftane (Third Grade) Retail | Gasoline Taxes |
|---|---|---|---|---|---|
| Dallas, Tex. | 7.5 | 10.5 | 6.5 | 8.5 | 5.5 |
| Ft. Worth, Tex. | 7.5 | 10.5 | 6.5 | 8.5 | 5.5 |
| Houston, Tex. | 8.5 | 12.5 | 7.5 | 10.5 | 5.5 |
| San Ant., Tex. | 8.5 | 12.5 | 7.5 | 10.5 | 5.5 |

Consumer tank wagon prices are 1c per gal. above the dealer tank wagon prices at Dallas and Ft. Worth.

| | Kerosine *Tank Wagon | Kerosine Retail |
|---|---|---|
| Dallas, Tex. | 7 | 10 |
| Ft. Worth, Tex. | 7 | 11 |
| Houston, Tex. | 8 | 11 |
| San Antonio, Tex. | 7 | 10 |

*To all classes of dealers & consumers.

## Canada

**PRICES OF IMPERIAL OIL, LTD.**

Per Imperial Gallon, which is 1.2 U. S. Gallons

### IMPERIAL OIL

3-Star Imperial Gasoline (Regular Grade)

| | †Gasoline T.W. | *Gasoline Taxes | Kerosine T.W. |
|---|---|---|---|
| Hamilton, Ont. | 16.5 | 11 | 18 |
| Toronto, Ont. | 16.5 | 11 | 18 |
| Brandon, Man. | 20.5 | 10 | 22.5 |
| Winnipeg, Man. | 20.0 | 10 | 22 |
| Regina, Sask. | 17.5 | 10 | 19.5 |
| Saskatoon, Sask. | 20.3 | 10 | 22.3 |
| Edmonton, Alta. | 18.4 | 10 | 20.4 |
| Calgary, Alta. | 15.5 | 10 | 17.5 |
| Vancouver, B. C. | 15 | 10 | 24 |
| Montreal, Que. | 16.5 | 11 | 17.5 |
| St. John, N. B. | 16 | 13 | 19 |
| Halifax, N. S. | 16 | 13 | 19 |

*Includes 3c Federal, and Provincia taxes.

†To divided & undivided dealers.

Above prices are those in effect May 17, 1945.

### SOCONY VACUUM

Socony Mobilgas (Regular Grade)

| | Com. Cons. T.W. | Undiv. Dlr. T.W. | Gasoline Taxes |
|---|---|---|---|
| New York City Manhattan & Bronx | 10.1 | 10.6 | *5.5 |
| Kings & Queens | 10.1 | 10.6 | *5.5 |
| Richmond | 9.7 | 10.2 | *5.5 |
| Albany, N. Y. | 9.9 | 10.4 | 5.5 |
| Binghamton, N. Y. | 11 | 11.5 | 5.5 |
| Buffalo | 9.6 | 10.1 | 5.5 |
| Jamestown, N. Y. | 9.8 | 10.3 | 5.5 |
| Mt. Vernon, N. Y. | 10.1 | 10.6 | 5.5 |
| Plattsburg, N. Y. | 11 | 11.5 | 5.5 |
| Rochester, N. Y. | 10.8 | 11.3 | 5.5 |
| Syracuse, N. Y. | 10.5 | 11 | 5.5 |
| Bridgeport, Conn. | 10 | 10.5 | 4.5 |
| Danbury, Conn. | 10.5 | 11 | 4.5 |
| Hartford, Conn. | 10.6 | 11.1 | 4.5 |
| New Haven, Conn. | 10 | 10.5 | 4.5 |
| Bangor, Me. | 10.7 | 11.2 | 5.5 |
| Portland, Me. | 10.3 | 10.8 | 5.5 |
| Boston, Mass. | 9.9 | 10.4 | 4.5 |
| Concord, N. H. | 11.4 | 11.9 | 5.5 |
| Lancaster, N. H. | 12 | 12.5 | 5.5 |
| Manchester, N. H. | 11.3 | 11.8 | 5.5 |
| Providence, R. I. | 10 | 10.5 | 4.5 |
| Burlington, Vt. | 10.9 | 11.4 | 5.5 |
| Rutland, Vt. | 11 | 11.5 | 5.5 |

(Continued on next page)

## Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices in Effect July 2.

### MOTOR GASOLINE

| District | 72 Oct. (ASTM) | 70-74 oct. (ASTM) |
|---|---|---|
| N. Y. Harb. | Not made | 9.075 |
| N. Y. Harb., barges | " | 8.5 – 8.975 |
| Albany | " | 9.175 |
| Philadelphia | " | 9.075 |
| Baltimore | " | 8.825 |
| Norfolk | " | 8.575 |
| Wilmington, N. C. | " | 8.175 |
| Charleston | " | 8.175 |
| Savannah | " | 7.845 |
| Jacksonville | " | 7.845 |
| Miami | " | 7.845 |
| Tampa | " | 7.845 |
| Pensacola | " | 6.875 (1) |
| Mobile | " | 6.62 – 6.745 |
| New Orleans | " | 6.125 (1) |
| Portland | " | 9.375 |
| Boston | " | 9.275 |
| Providence | " | 9.275 |

### FUEL OILS

| District | KEROSINE and/or NO. 1 FUEL | No. 2 | No. 3 | No. 5 | No. 6 |
|---|---|---|---|---|---|
| N. Y. Harb. | 7.1 | 6.7 | 6.7 | $1.85–$1.95(a) | $1.77 |
| N. Y. Harb., barges | " | 6.6 | 6.6 (2) | .... | .... |
| Albany | 7.3 | 6.8 | 6.8 | .... | $1.97 (1) |
| Philadelphia | 7.2 | 6.7 | 6.7 | $1.98 | $1.77 |
| Baltimore | 7.2 | 6.7 | 6.7 | $1.85 (1) | $1.77 |
| Norfolk | 7.1 | 6.7 | 6.7 (1) | $1.85 (1) | $1.77 |
| Wilmington, N. C. | 6.75 | 6.4 | .... | .... | .... |
| Charleston | 6.9 | 6.4 (2) | .... | $1.80 (1) | $1.72 (2) |
| Savannah | 6.55 | 5.75 (1) | .... | .... | $1.72 (1) |
| Jacksonville | 6.55 | 5.75 | .... | .... | $1.72 (2) |
| Miami | 6.55 | 5.75 (1) | .... | .... | .... |
| Tampa | 6.55 | 5.75 | .... | .... | $1.62 |
| Pensacola | 4.8 (1) | .... | .... | .... | .... |
| Mobile | 4.75 (2) | .... | .... | .... | .... |
| New Orleans | 4.125–4.25 | 3.75 (2) | .... | $1.05(1) | $0.97 |
| Portland | 7.3 | 6.8 | 6.8 (2) | .... | $1.77 |
| Boston | 7.2 | 6.7 | 6.7 (2) | $1.95 (2) | $1.77 |
| Providence | 7.2 | 6.7 | 6.7 (2) | $1.90 (1) | $1.77 |

## Pacific Export

*In Ship's Bunkers, or deep tank lots:*

| Prices in Effect | July 2 | June 25 |
|---|---|---|
| Diesel Fuel, Pac. Spec. 200 | $1.45 | $1.45 |
| Grade C fuel, Pac. Spec. 400 | $1.10 | $1.10 |

**Seaboard Export Coastwise Prices**

| | Bunker C Fuel Ships' bunkers (Ex Lighterage) | Diesel Oil Ships' bunkers (Ex Lighterage) | Diesel Oil Shore Plants | Gas House Gas Oil 28-34 Gravity |
|---|---|---|---|---|
| New Haven | $1.77 | .... | .... | .... |
| N. Y. Harbor | $1.77 | $2.78 | 6.7 (1) | 6.8 (2) |
| Albany | $1.97 (1) | $2.94 (1) | 6.8 (1) | 7 (1) |
| Philadelphia | $1.77 | $2.78 | .... | .... |
| Baltimore | $1.77 | $2.78 | 6.7 (1) | 6.7 (1) |
| Norfolk | $1.77 | $2.78 | 6.7 (1) | 6.7 (1) |
| Charleston | $1.72 (2) | $2.66 (2) | 6.4 (1) | 6.4 (1) |
| Savannah | $1.72 (1) | $2.52 (1) | .... | .... |
| Jacksonville | $1.72 (2) | $2.41 (2) | .... | .... |
| Tampa | $1.62 | $2.41 (2) | .... | .... |
| New Orleans | $0.97 | $1.65 (1) | 4 (1) | .... |
| Portland | $1.77 | .... | 6.8 (1) | 6.9 (1) |
| Boston | $1.77 | $2.78 (2) | 6.7 (2) | 6.8 (2) |
| Providence | $1.77 | $2.78 (2) | 6.7 (1) | 6.8 (1) |

Bunker "C" when from Navy storage at New York and Norfolk to out-going vessels ships $1.72. (Subject to cancellation.)

## Tank Wagon Prices (Continued)

| | *Mineral Spirits T.W. | V.M.&P. T.W. |
|---|---|---|
| Buffalo, N. Y. | 12.4 | 13.6 |
| New York City | 11 | 12 |
| Rochester, N. Y. | 13.2 | 14.4 |
| Syracuse, N. Y. | 14 | .... |
| Boston, Mass. | 12 | 13 |
| Bridgeport, Conn. | †16.3 | †17.3 |
| Hartford, Conn. | †16.3 | †17.3 |
| Providence, R. I. | 13 | 14 |

| | Kerosine Yard | Kerosine T.W. | Mobilfuel Diesel T.C. | Mobilfuel Diesel T.W. | Mobilheat Fuel Yard | Mobilheat Fuel T.W. |
|---|---|---|---|---|---|---|
| New York: | | | | | | |
| Manhat'n & Bronx | 7.5 | 10.3 | ... | 9.3 | 7.1 | 9 |
| Kings & Queens | 7.5 | 10.3 | ... | 9.3 | 7.1 | 9 |
| Richmond | 7.5 | 10.3 | ... | ... | 7.1 | 9.0 |
| Albany | 7.5 | 9.8 | 6.8 | 9.3 | 7 | 9 |
| Binghamton | 8.9 | 11.2 | ... | 10.7 | 8.4 | 10.2 |
| Buffalo | 8.1 | 10.4 | 7.5 | 9.8 | 7.7 | 9.5 |
| Jamestown | 8.2 | 10.5 | ... | 10.1 | 7.8 | 9.5 |
| Mt. Vernon | 7.6 | 10.3 | ... | 9.4 | 7.2 | 9 |
| Plattsburg | 8.1 | 10.4 | ... | 9.9 | 7.6 | 9.4 |
| Rochester | 8.7 | 11 | 7.9 | 10.2 | 7.9 | 9.7 |
| Syracuse | 8.5 | 10.8 | 7.8 | 10.1 | 7.8 | 9.6 |
| Conn.: | | | | | | |
| Bridgeport | 7.8 | 10.3 | ... | .... | 7.3 | 9.0 |
| Danbury | 8.2 | 10.8 | ... | .... | 7.8 | 8.5 |
| Hartford | 8.0 | 10.5 | ... | 9.5 | 7.4 | 9.2 |
| New Haven | 7.5 | 10.3 | ... | 9.3 | 7.1 | 9.0 |
| Maine: | | | | | | |
| Bangor | 7.9 | 10.3 | 7.4 | 9.7 | 7.4 | 9.1 |
| Portland | 7.5 | 10.2 | 6.8 | 9.3 | 7 | 9 |
| Mass.: | | | | | | |
| Boston | 7.8 | 10.6 | 6.7 | 9.2 | 7.1 | 9 |
| N. H.: | | | | | | |
| Concord | 8.4 | 10.7 | ... | ... | 8.2 | 10 |
| Lancaster | 9.5 | 11.8 | ... | .... | 9.2 | 11 |
| Manchester | 8.5 | 11.1 | ... | .... | 7.9 | 9.7 |
| R. I.: | | | | | | |
| Providence | 7.8 | 10.1 | 6.7 | 9.2 | 7.1 | 9.0 |
| Vermont: | | | | | | |
| Burlington | 8.1 | 10.4 | 7.5 | 9.8 | 7.5 | 9.2 |
| Rutland | 8.3 | 10.6 | ... | 10 | 7.7 | 9.5 |

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).
†In steel barrels
Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

## Gulf Coast

Prices in Effect July 2

| MOTOR GASOLINE | New Orleans & Lower Mississippi to Baton Rouge Tank Cars | New Orleans & Lower Mississippi to Baton Rouge Barges | Texas Gulf Coast South of New Orleans Tank Cars | Texas Gulf Coast South of New Orleans Barges | CARGOES Domestic & Export From all Gulf Ports |
|---|---|---|---|---|---|
| **Leaded (oct. by ASTM)** | | | | | |
| 76 oct. | 6.75 | 6.5 | 6.75 | 6.75 | 6.75 |
| 70-74 oct. | 6 – 6.125 | 5.625 | 5.625–6.375 (a) | 5.625 | 5.625 |
| 63-65 oct. | .... | .... | .... | .... | .... |
| **Unleaded 70 oct.** | .... | .... | .... | .... | 5.625 |
| 67-68 oct. | .... | .... | .... | .... | .... |
| 65 oct. | .... | .... | .... | .... | 5.25 |
| 60 oct. | .... | .... | .... | .... | 5 |
| **KEROSINE & LIGHT FUELS** | | | | | |
| 41-43 w.w. kero. | 4.125– 4.25 | 4.125 | 4.125– 4.25 | 4.125 | 4.125 |
| 42-44 w.w. kero. | .... | .... | 4.125 | 4.125 | 4.125 |
| No. 2 fuel oil | 3.75 | 3.75 | 3.75 – 4 | 3.75 | 3.75 |
| **DIESEL & GAS OILS** | | | | | |
| (In diesel index No.) | | | | | |
| No. 5 fuel oil | $1.05 | .... | $1.05 | .... | .... |
| 43-47 di | .... | .... | .... | .... | 4 |
| 48-52 di | 4 | 4 | 4 | .... | 4 |
| 53-57 di | 4.125 | .... | 4.125 | 4.125 | 4.125 |
| 58 and above | 4.25 | .... | 4.25 | .... | 4.25 |

(a) 5.625c for Dist. 1 and 6.125-6.375c for other districts.
NOTE: Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

## EXPORT PRICES

Effective July 2

| | Mexican Gulf Ports U. S. Dollars per Bbl. Bunker C | Diesel |
|---|---|---|
| Tampico | $0.97 | $1.65 |
| Veracruz | 0.97 | .... |
| Coatzacoalcos | 0.97 | 1.65 |
| | **Pacific Coast** | |
| Guaymas | $1.50 | $3.22 |
| Mazatlan | 1.50 | 3.22 |
| Acapulco | 1.50 | 2.89 |
| Manzanillo | 1.50 | 2.89 |
| Salina Cruz | 1.50 | 2.89 |

| Heavy Fuels & Bunker Oil (at all Gulf Ports) Heavy Diesels | In Cargoes | In Ship's Bunkers (Ex Lighterage) |
|---|---|---|
| Below 28 API Grav. | .... | $1.35 |
| 28 & above API Grav. | .... | $1.65 |
| Bunker C Oil | $0.97 | $0.97 |

## Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals).

Prices in Effect July 2

| | Steel Drums | Bulk |
|---|---|---|
| Bright Stock | | |
| *D color, Vis at 210°* | | |
| 200 vis. | .... | .... |
| 150 vis., 0-10 p.p. | 32.65 (1&a) | 24.8 (1) |
| 100 vis., 0-10 p.p. | .... | .... |
| 100 vis., 10-25 p.p. | .... | .... |
| Neutral—No. 3 color | | |
| 200 vis., 0-10 p.p. | .... | .... |

(A) FAS at New Orleans.

## Wax

(Melting points are AMP, 3° higher than EMP) Prices are FOB refinery and do not include bag; freight or export differentials).

Prices in Effect July 2

| Crude Scale | New Orleans Export | N. Y. Domestic | N. Y. Export |
|---|---|---|---|
| 124-6 Yellow | 4.25 (1) | .... | 4.25 (1) |
| 122-4 White | .... | 4.25 (2) | 4.25 (2) |
| 124-6 White | 4.25 (1) | 4.25 | 4.25 |
| Fully Refined: | | | |
| 123-5 | 5.2 (1) | 5.2 (2) | 5.2 (1) |
| 125-7 | 5.2 (1) | 5.2 (2) | 5.2 (1) |
| 128-30 | 5.6 (1) | 5.6 | 5.6 (1) |
| 130-32 | 5.85 (1) | 5.85 (2) | 5.85 (1) |
| 133-5 | 6.15 (1) | 6.15 | 6.15 (1) |
| 135-7 | 6.4 (1) | 6.4 (1) | 6.4 (1) |

## Naphtha

Prices in Effect July 2

| | V.M.&P. Naphtha | Mineral Spirits |
|---|---|---|
| New York Harbor | 11 (2) | 10 |
| Philadelphia | 11 (2) | 10 |
| Baltimore | 10.5 (2) | 9.5 |
| Boston | 11.5 (2) | 10.5 |
| Providence | 11.5 (1) | 10.5 (2) |

# CLASSIFIED

## For Sale

FOR SALE: 3500 gal. Spencer semi-trailer Tank; good condition, good tires. Deem Oil Company, Tenth and Market, E. St. Louis, Illinois.

FOR SALE: 100,000 gallons SAE No. 40, U. S. army specification 2-104-B motor oil; available tank car, transport, or drums. Price open, subject to negotiation. Box No. 620.

**TRANSPORT TANK TRUCK**
**Complete Unit**

One 3400-gallon, 4-compartment, semi-Tank Trailer and International Tractor. This equipment now available for immediate sale.

Olympic Hi-Speed Corporation
14002 Lake Shore Blvd., Cleveland 10, Ohio
Phone: Kenmore 2727

**FIRE-FIGHTING EQUIPMENT**

Two 2½ gallon Foamite Extinguishers
Two 40 gallon Foamite Extinguishers on wheels, Model FM

Mercury Oil Refining Company
Box 891, Oklahoma City, Okla.

**FOR SALE**
**STORAGE TANKS**

Steel storage tanks ranging from 5,000 gallon to 30,000 Barrel capacity.
One (1) 200,000 cu. ft. Gas-relief Holder.

WE WELCOME ALL INQUIRIES

**Empire Tank & Salvage Co.**
1451 Broadway New York 18, N. Y.
Phone: Lackawanna 4-5760

**UNUSUAL OPPORTUNITY**

Why pay $1.00 or $1.50 for cleaning and reconditioning your barrels and drums when you can do it yourself for 40c or 50c and have them on hand whenever you need them, and still get back 25% on your investment. This is a once-in-a-lifetime opportunity to buy a complete barrel and drum reconditioning plant at a bargain. For further information write—

George P. Engelhardt,
Box 236, Pleasanton, Calif.

**TRANSPORT BARGAINS**

3—Model WA-34, 1943 White Tractors.
4—4500 gal., 3 compartment, Davis Tank Trailers, equipped with air brakes and 11.00 x 22 newly recapped tires.
1—4500 gal., 3 compartment, Standard Steel Tank Trailer, air brakes and 11.00 x 22 newly recapped tires
1—4100 gal., 3 compartment, Standard Steel Tank Trailer, air brakes and 11.00 x 20 newly recapped tires.
1—Model LFT Mack Tractor, air brakes, 11.00 x 22 newly recapped tires.

All of the above equipment is newly painted and in excellent mechanical condition.

UDELSON TRUCK SALES
3314 Woodland Ave., Cleveland, Ohio.

## For Sale

**FOR SALE**

Finely located Filling Station which is a real volume producer. Bulk Plant for sale or will retain and supply products on a basis that will produce good profits.

L. L. Coryell & Son
Lincoln, Nebraska

**FOR SALE**

1 Tank 10′ diameter by 30′ long, ¼″ plate, flat heads, riveted construction. 17,750 gal. capacity.
6 Tanks 10′ diameter by 30′ long, ⅛″ plate, welded construction, dished heads, 18,000 gal. capacity each.

Empire Equipment Corporation
608 Empire Bldg., Cleveland 14, Ohio
Phone: Main 7667

**FOR SALE**

150—8000 gal. R.R. Tank Cars.
30—6000—8000—10,000 gal. Car Tank Shells.
8—15,000 & 20,000 gal. Tanks.
175 gal. Jones Oil Heater.
2—20 H.P. Charlotte Colloid Mills.

R. C. STANHOPE, INC.,
60 East 42nd St., New York 17, N. Y.

**FOR SALE**

Several late model 4000 gallon gasoline Transports, some with Tractors, some without Tractors, all in first-class condition. Write or wire—

G. E. BOBBITT
Box 1055, Raleigh, N. C.
Telephone 3-1793.

**NEBRASKA**

16th Annual Statistical Survey
Distribution Petroleum Products

Facts and Figures of oil marketing operations by companies and localities in 1944.

Motor vehicle registrations and Tractors by counties, Transporters and Tax Data.

Invaluable in planning sales promotion and dealership campaigns.

$5.00 per Copy

Nebraska Petroleum Marketers, Inc.
705 Security Mutual Building
Lincoln 8, Nebraska

## Wanted to Buy

**WANTED TO BUY**

Responsible group of individuals with oil marketing experience desires to acquire jobber business or distributor franchise, preferably in one of the southern states.

Box No. 618

## Situations Open

**ENGINEER—TANK DESIGNER**

Wanted, capable of estimating and designing tank and general plate work. Must have experience. Excellent permanent opportunity for right young man. Apply—

R. E. Jones,
P.O. Box 2632, Birmingham, Ala.

## Situations Open

WANTED: Independent Refinery in Southwest Oklahoma needs Refinery Chemist. Position permanent. State age, qualifications, experience, salary expected, draft and availability status. Box No. 621.

SALESMAN to sell lubricating oils, gasoline, complete line petroleum products in north Texas area and southern Oklahoma area for large independent refiner. State experience fully and salary basis desired. Box No. 623.

CHEMICAL ENGINEER: Large midwestern oil company requires graduate Chemical Engineers for process design, process control and refinery technical service work. Positions permanent. Write Box No. 622, giving qualifications and experience if available under W.M.C. regulations.

AN AGGRESSIVE INDEPENDENT OIL company doing business in the Rocky Mountain area, is now interviewing applicants for position as road oil and asphalt salesman. Experience contacts and ambition are all you need. Successful applicant will have charge of all road oil sales in territory where opportunity is unlimited. If interested in good income, permanent position in growing business now and post-war, write Box No. 625, National Petroleum News, 1213 West Third St., Cleveland 13, Ohio.

**WANTED SALESMANAGER**

Independent marketer in southeastern territory offers unusual opportunity to energetic and capable sales executive thoroughly familiar with fuel oils, lubricants and oil specialties. Applicants must have at least 10 years oil experience. Give full details of your past activities stating age, education and availability.

Our organization knows about this ad. Write—

Box No. 616

**REFINERY ENGINEERS WANTED**

Refinery Process Engineers having from two to five years experience in preparation of calculations for design or control of fluid catalyst cracking, alkylation, or light ends fractionation processes. Growing Refinery technical organization offers excellent opportunities for advancement to capable engineers.

MUST COMPLY WITH W.M.C. REGULATIONS

Address reply to—

Box No. 624

National Petroleum News

**MEN FOR FOREIGN EMPLOYMENT**

**In Saudi Arabia**

Refinery operators; graduate petroleum, electrical and mechanical engineers; stabilizer operators; combination welders for pressure vessel and pipe work; boilermakers and various other crafts; accountants; stenographers.

Employment offers opportunities for post-war security and advancement. Liberal benefit plans; vacations in United States; free hospital and medical care.

If genuinely interested in foreign career, send full information on experience, transcript of college record (professional applicants only), references, draft and availability status to our Employee Relations Department.

ARABIAN AMERICAN OIL COMPANY
200 Bush Street
San Francisco 4, California

(*Additional Classified p. 66*)

# ABOUT OIL PEOPLE

Bjorksten Laboratories, Chicago, announce that **Stuart O. Fiedler,** B. S., Ch. E., has joined their staff as a research associate. Mr. Fiedler is also a member of the American Chemical Society and of the American Association of Textile Chemists and Colorists.

° ° °

**Frank Spencer,** head of the fuel oil department, Socony Vacuum, Chicago, has been released from the hospital following an operation to remove several cartilages from the knee.

° ° °

**Dr. A. D. Ayers,** chemical engineer of the California Institute of Technology, was guest speaker at a dinner meeting of the American Institute of Mining and Metallurgical Engineers held in Los Angeles.

° ° °

**Robert McKeon** of Los Angeles recently completed drilling of the George Atha Exploration test well on contract at Huntington Beach, and has returned to his Los Angeles office.

° ° °

**Lum Price,** veteran Humble Oil & Refining Company salvage expert, has been elected head of the Houston Committee for Industrial Salvage, and is assisted by some 1100 Houston firms. Up to May 1 of this year the committee has shipped 413,000 tons of salvageable scrap material to reclamation depots, including thousands of tons of heavy melting iron and steel scrap.

° ° °

**Charles H. Pishny** of Berger & Pishny, Fort Worth, Tex., has been elected chairman of the North Texas section of the American Institute of Mining and Metallurgical Engineers, recently organized.

° ° °

**Louis Elington,** California oil producer, was a recent visitor to Los Angeles. He is active in the Ojai district, where he has considerable prospective acreage.

° ° °

**Fred V. Gordon,** pioneer oil producer, still is confined to his home in Los Angeles by leg injuries suffered when he fell several weeks ago.

° ° °

R. **Werlin,** who recently resigned as chief of the Facilities Section, Refining Division, Petroleum Administration for War, has opened offices in Houston and resumed the practice of patent law.

° ° °

L. **Phillip Magee** of Little Rock, Ark., district manager for Gulf Refining Co., was elected chairman of the Arkansas Petroleum Industries Committee at a recent meeting of the executive committee here.

T. **M. Martin,** of El Dorado, executive vice-president of the Legion Oil Refining Co., was re-elected a vice-chairman, and **C. C. Breeding,** division manager of the Arkansas Fuel Oil Co., was elected a vice-chairman. **W. F. Scarborough,** of Little Rock, was re-elected executive secretary of the committee.

° ° °

**Lounsbury S. Fish,** organizational counsel for Standard of California, will help develop organizational planning in occupied Germany for the guidance of the army, both in military government and civil administration, it was announced in Los Angeles.

Mr. Fish will aid **Lieut. Gen. Lucius Clay,** Deputy Military Governor in Germany, in setting up the organization.

° ° °

The appointment of two new members and their alternates to the recently activated North Africa Supply and Distribution Committee, a subcommittee of the Foreign Operations Committee, which will participate actively in supplying North Africa as soon as the military situation permits and as long as wartime product and transportation shortages exist, was approved today by Deputy Petroleum Administrator Ralph K. Davies.

The new members are **H. A. Hassam,** of New York City, and **B. H. Morris,** of Edgewater, N. J. Their alternates are **A. H. Watts,** of New York City, and **C. J. Fetzner,** of Edgewater, N. J.

The other members of the committee are **N. Goddard, L. K. Blood, J. Parkinson, W. H. Dunning** and **H. A. Thomas,** all of New York City; **B. P. Newton,** Pittsburgh, Pa., and **J. E. Wooler,** Philadelphia, Pa.

° ° °

**Charles F. Holmes,** of Chicago, assistant director, PAW Dist. 2 facilities securities division, who has been confined to his home for more than a week on account of illness, is reported making progress toward recovery.

## Wisconsin Oil Men Topple Chicagoans

**Acquiring this season's first sun tans at the ninth annual golf tournament of Wisconsin Petroleum Assn. at Quit-Qui-Oc Country Club, Elkhart Lake, on June 21, are (left to right) E. S. Burton, Don Reed, Charles Remlinger, E. J. Walters, Ken Savage, Hub Vogt, Roger Girard, Andy O. Blasing and Austin Story**

At the ninth annual golf tournament of the Wisconsin Petroleum Assn. held at Quit-Qui-OC country club at Elkhart Lake, Wis., on June 21, the association's team, competing with members of the Chicago Oil Men's Club, took everything away from the Windy City group except the faint odor of success. **M. L. Prellberg** of the six-man Chicago team was the only winner from out of state, underscoring Mel Teige of Wisconsin.

The five winners on the Wisconsin team were **Roy Jacobs** of Ahrens Oil Co., Mukwonago, who also won first prize for low gross of 74; **Dave Wilson** of Madison, with second low gross of 76; **Jack O'Connor** of Madison, **Ted Grasse** of Sheboygan and **A. C. Breuch** of Madison. The blind bogey was split between **F. Ellsworth** and **L. Nelson.** Other prizes went to **A. O. Blasing** of Chicago, for the longest first hole drive; **Hal Freer** of Rockford, Ill., and **O. E. Ahrens** of Mukwonago.

A banquet and floor show at the Schwartz Hotel followed.

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**Alfred J. Hocking** has been promoted to assistant district manager for The Texas Co. in Chicago, effective June 1, a recent announcement by H. H. Winde, Texaco's Buffalo district manager, says.

Mr. Hocking joined the Texaco organization in January, 1926 as a sales representative with the Goodyear - Wende Oil Corp., the company which became the Buffalo district of The Texas Co. in 1928.

Mr. Hocking

He spent two years in Washington, first as assistant chief of the Joint Use Facilities Section, and later as chief of the Motor Fuels Section of the Division of Distribution and Marketing of PAW. A year ago he returned to the staff of the Buffalo district.

° ° °

Mr. Goebel

Mr. Sargent

**C. J. Kurz**, general sales manager of The National Refining Co., announces the appointments of **Frank Sargent** as manager of the Industrial Department, and **C. K. Goebel** as manager of the Jobbers Sales Department.

Mr. Sargent has been associated with research, development and applications of cutting and other industrial oils since joining the company in 1934. Mr. Goebel has been manager of the company's East Central Division.

° ° °

**Charles E. Foster,** vice president of Cities Service Oil Co. (Pa.) has retired after 40 years service with the organization.

A native of Chillicothe, Mo., Mr. Foster started with the St. Joseph Railway, Light Heat & Power Co. as a clerk in 1902, was made comptroller of the Crew Levick Co. in March 1917 and vice president in 1926. He became president of Cities Service Oil Co. (Pa.) in 1936. He was president of Penn. Oil Co. and an official of various other Cities Service subsidiaries.

° ° °

**J. G. Johnson,** vice president of Sinclair Refining Co., has been elected chairman of the American committee of Lloyd's Register of Shipping, it was announced here recently.

Mr. Johnson, who will serve a two-year term, has been manager of Sinclair's marine department for the last 28 years. He was previously with Jacobs & Davies, consulting engineers, of New York, and he had charge of the appraisal for the Boston and New York Navy Yards in 1909.

° ° °

**A. H. Weyland** was elected vice-president and general manager, and director of the Arkansas Louisiana Gas Co., Arkansas Natural Gas Corp., Arkansas Fuel Co., and Arkansas Pipeline Corp. at a recent meeting in New York.

A. H. Weyland

Mr. Weyland joined the Cities Service organization in 1919 in Bartlesville, Okla., as a junior engineer with the Empire Companies. He later was on assignments in the states of Arkansas, Texas, Kansas, and in 1925 became district superintendent of the Natural Gas & Fuel Co. in El Dorado, Ark. The following year he moved to Tullos, La., as district superintendent in charge of drilling and production in the Urania field. In 1928 he was promoted to the position of superintendent of oil production, Arkansas Natural Gas Co. In 1933 he was made general superintendent in charge of all operations of the Arkansas Natural and associated subsidiaries. In 1936 he was elected vice-president of the Arkansas-Louisiana Gas Co., a subsidiary of the Arkansas Natural Gas Corp.

° ° °

Announcement has been made of the addition of two new members to the board of directors of Pennsylvania Central Airlines. They are **George W. Mason,** president of the Nash-Kelvinator Corp. and **David L. Frawley,** vice-president of the Barnsdall Oil Co. Both are from Pittsburgh.

° ° °

**W. E. Griffeth,** former wholesale manager for Cities Service Oil Co., has become field director for Empire State Petroleum Assn., and will direct organization work for the Association throughout the state, it was recently announced.

Mr. Griffeth

Entering the oil industry in 1929 with Socony - Vacuum Oil Co., Mr. Griffeth served the company as jobber salesman, retail salesman and sales supervisor. In 1934 he became eastern wholesale man for Continental Oil Co. and in 1935 joined Crew Lavick Co., a Cities Service subsidiary.

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NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to
REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

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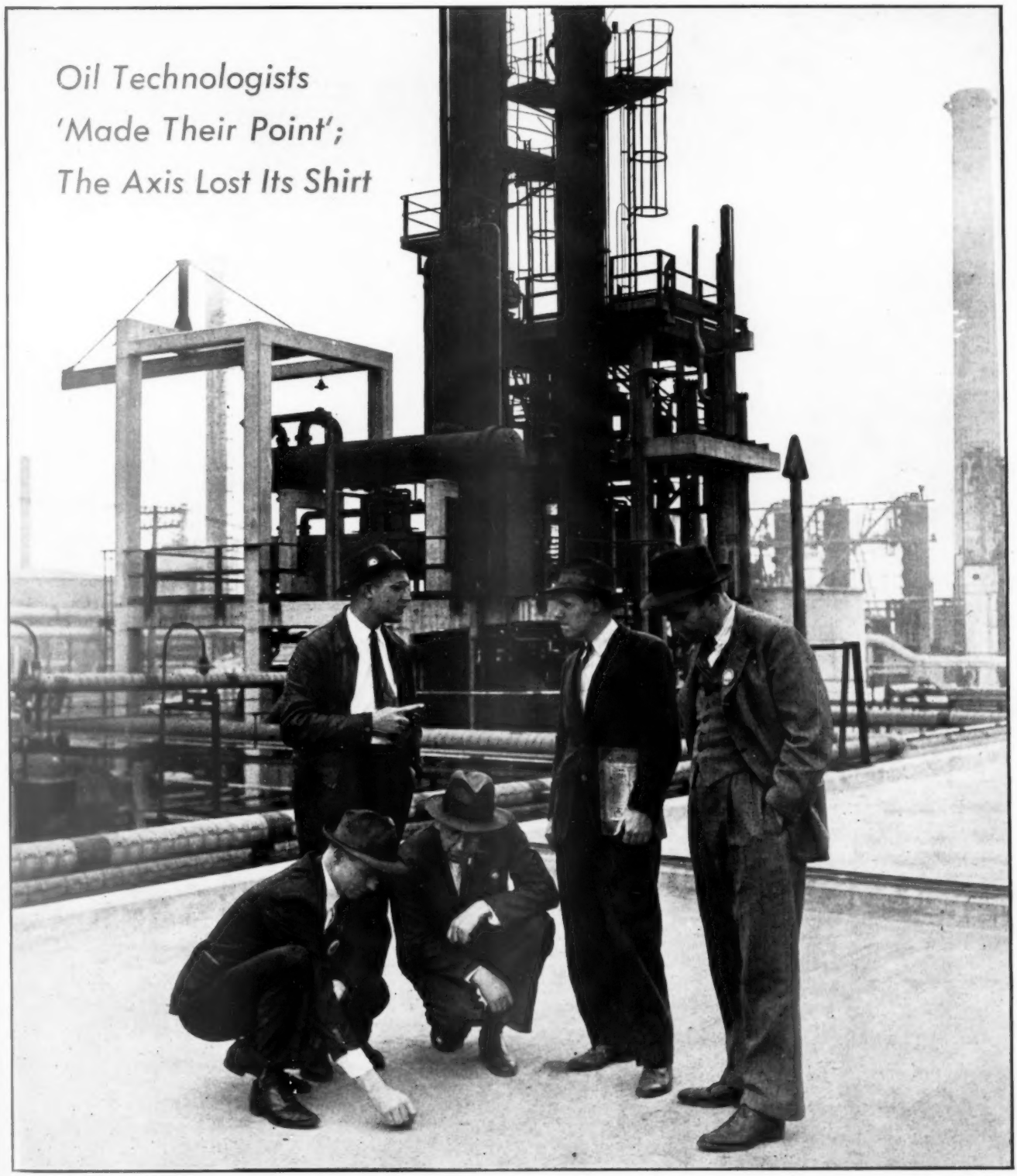
Section Two

July 4, 1945—Vol. 37, No. 27

# Oil Technologists 'Made Their Point'; The Axis Lost Its Shirt



What looks like a crap game is an impromptu conference of Standard Oil Co. (Ind.) technologists on an operating problem at the company's Whiting refinery. B. L. Evering studies W. K. Brown's sketch, drawn on the roof. Standing (L to R) are G. S. Weems, J. A. Bauer and N. Fragen. In the background is one of the company's Naphtha Isomerization units.

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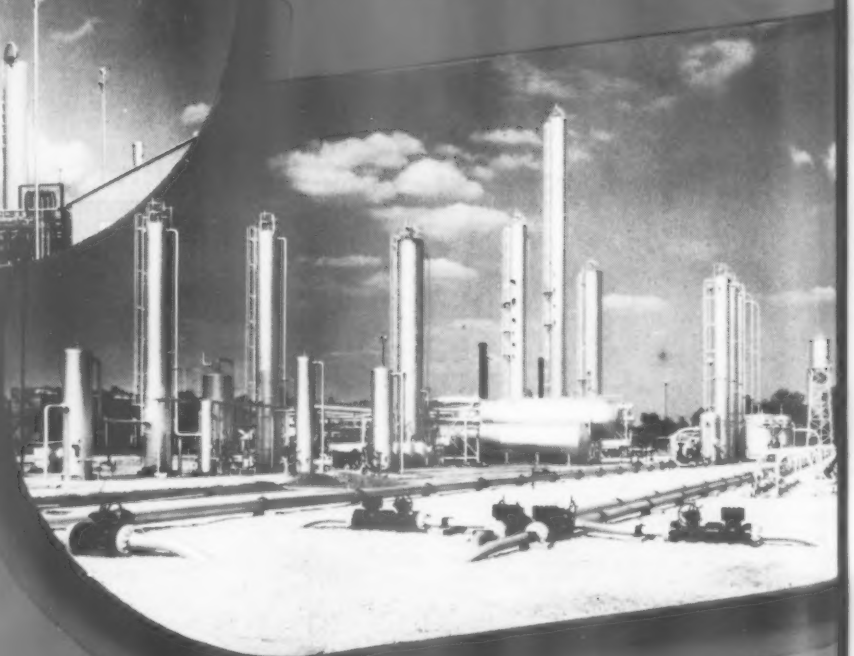

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D. P. Thornton, Jr., Assistant Editor • William F. Bland, Engineering Editor

# PREVIEW

## Feature Articles Coming Next Month

### At Last! Inspection Manual For Refinery Equipment

To aid refiners in the wartime program in keeping their plants at maximum efficiency, PAW with the cooperation of engineers of several oil companies prepared recommended procedure for refinery inspection. This represents the completion of work started in the refining industry several years ago to set up good practice for plant inspections.

The PAW inspection manual was at once recognized as of value to refiners in general, particularly those with small plants. Accordingly it has been made available to the industry by PAW. NPN's Technical Section is publishing the manual to bring it to the attention of plant operators everyhere.

An installment of the first part, covering Processing Equipment, appears in the current issue and this part will be continued in August and concluded in September. Installments of other parts of the manual will appear in later issues.

### Basis for Organizing Unitized Cycling Plant

"Haynesville is an outstanding example of the adaptation of the principles of representative democracy to the problems of cooperative oil field operations . . ."

This is a quotation from a coming article by a well known authority on the new unitized cycling operation in the Haynesville oil and gas field. In addition to discussing the organization setup in which a number of oil companies share equitably, the article will describe engineering features of the project.

Exclusive in the Aug. 1st NPN Technical Section.

### Developments in Refining As Disclosed in Patents

New and improved processes in petroleum refining, developed during the war but which have thus far been held under secrecy, will soon be coming into public notice through the issuing of patents under normal procedure.

To insure that its readers are informed on such developments as reported through this source of information, NPN's Technical Section has arranged with a leading authority in this field to screen patents issued in the U. S., and in other countries in so far as information concerning them is available in the literature, and to describe those which reflect important new trends.

See pg. R-504 for the first installment of this important new feature.

# THE BUS HAS HELPED TO PUT THE MAN IN MANPOWER

A MAN doesn't become manpower until he punches in at the factory gate. Today it doesn't matter much whether he lives one mile from the plant or thirty miles away—as long as there is a bus at hand to take him to work.

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The bus industry can indeed be proud of its wartime record in carrying tremendously increased numbers of passengers in spite of shortages of equipment, parts and skilled help.

The war has brought home how important a part gasoline plays in the transportation system of this nation. We, of Ethyl, are glad to have been able to contribute to the improvement of engines and fuels and look forward to continuing cooperation with both manufacturers and operators in the future.

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REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

July 7, 1945
Volume 37
Number 27

MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

# RECOMMENDED REFINERY INSPECTION PROCEDURE IS PREPARED BY P.A.W.

RECOMMENDATIONS for standard refinery inspection practice have been prepared by a group of oil company engineers under the auspices of the Petroleum Administration for War and are now available to all refiners.

The refinery inspection manual was originally prepared to give all the plants in the wartime program the benefit of the best experience and engineering knowledge within the refining industry, to aid them in maintaining their plants at maximum efficiency in the production of essential wartime products. Consequently it covers instruments and other newer types of plant equipment, as well as the standard processing equipment.

The value of the inspection recommendations in refinery operations generally has been widely recognized and they are being offered by PAW to the refining industry under the title "Wartime Recommendations for Refinery Inspections."

Through arrangements with PAW these recommendations will be presented in full in a series of articles in NPN's Technical Section, starting with this issue.

While every refining plant large and small carries on more or less systematic inspection of its equipment as necessary to efficient plant operations, this is the first time that the procedures of many companies have been studied and their best features compiled into a guide for refinery management and supervisory personnel.

The manual is in four sections covering process equipment, electrical equipment, instruments and fire protection equipment.

Each section describes the organization of an inspection department for that type of equipment; and lists the qualifications for inspectors as well as giving detailed instructions for the inspection of individual items of equipment. An important feature of the manual is an appendix of working charts giving, for example, the retiring thickness of various metals and alloys under various operating temperatures and pressures; also working drawings showing how to fashion special tools for inspection work, among other illustration features.

The preface to the refinery inspection manual states that the recommendations were the result of a feeling on the part of PAW and of the Committee on Protection of Petroleum Facilities of the Petroleum Industry War Council that an inspection manual should be developed which would serve as a guide for refinery management and supervisory personnel during the war period.

PAW representatives who helped to produce the manual pay tribute to the help of members of the American Petroleum Institute Committee of Refinery Inspection Supervisors and to industry representatives who were instrumental in the creation of the manual. PAW also expresses appreciation to the oil companies who authorized use of certain engineering data and charts which have been incorporated in the manual.

The foundation of the present manual, the preface states, was the "Tentative API Code of Good Practices for Refinery Inspection Procedures" which was being assembled by the API Committee of Refinery Inspection Supervisors, under the chairmanship of F. L. Newcomb, Standard Oil Development Co., at the outbreak of the war. Refining industry representatives who contributed much time and effort to the final draft of the manual are given in Table 1.

"While it should be emphasized" states the preface, "that this data was of necessity hurriedly assembled and there possibly have been omissions, it is the feeling of all those participating in the work that accuracy is of such high order that there is justification in submitting it to the industry as a workable document."

"It is recognized that, due to the large variety of equipment

TABLE 1—Representatives of the Refining Industry and PAW Contributing in the Preparation of the Refinery Inspection Manual

**Advisors on the Complete Manual:**

F. A. Birely, Sun Oil Co.
F. B. Bluhm, Sinclair Refining Co.
W. L. Bowler, Pure Oil Co.
F. C. Braun, Gulf Oil Corp.
J. K. Deichler, Atlantic Refining Co.
H. G. Hall, The Texas Co.
W. A. Howard, Socony-Vacuum Oil Co., Inc.
F. L. Newcomb, Standard Oil Development Co.
T. D. Radcliffe, Standard Oil Co. (California)
T. V. Sheehan, Standard Oil Co. (Indiana)
Dan Smith, Standard Oil Co. (Indiana)
H. F. West, Standard Oil Co. (Ohio)

**Advisors on the Instrument Section:**

E. J. Grace, Sun Oil Co.
W. A. Hagerbaumer, Socony-Vacuum Oil Co., Inc.
H. F. Moore, Standard Oil Development Co.
J. A. Pellettere, Gulf Oil Corp.
M. H. White, Atlantic Refining Co.
C. A. Williams, Sinclair Refining Co.

**Advisors on the Electrical Equipment Section:**

C. M. Hoag, Union Oil Co.
E. J. Nopper, Sun Oil Co.
L. E. Priester, The Texas Co.
M. H. White, Atlantic Refining Co.

**PAW Representatives:**

Frank A. Epps, Facility Security Division
William K. McCoy, Facility Security Division
Frank S. Proctor, Facility Security Division
John M. Waters, Materials Division
Franklin G. Wilson, Refining Division

in general use, the scope of the recommendations must be general in nature. There is no intent to discourage methods which may be appropriate for special processes and which may not be covered herein. The manual was prepared only as a general guide for independent inspection procedures with the thought of improving the standards of inspection, to the end that greater safety and continuity of operation may be achieved."

The Introduction to the PAW refinery inspection manual is as follows:

"This manual is intended as a guide for the inspection of existing operating equipment and is not intended to be used to govern the purchase of new equipment. It is presumed, however, that equipment in service, or to be installed, will conform with existing recognized specifications or codes. It is further assumed that defects discovered by proper inspection will be remedied in accordance with good maintenance standards, and that repairs will follow, in general, procedures and methods outlined in existing codes, using materials conforming with recognized specifications at the time of fabrication or repairs.

"It is recognized that, as the art of the industry progresses, there may be a number of unforeseen conditions which will render portions of this manual inapplicable and hence certain deviations may be necessary at the discretion of the management.

"The manual is not intended to be applicable to equipment subject to state or federal government regulations, such as marine equipment, power boilers, or other apparatus specifically defined by law. Further, it is not intended to apply to the inspection of mechanical tools used in the maintenance of refinery apparatus or to certain types of specialized equipment used in laboratories or pilot plants, especially where used in experimental work at extreme pressures or temperatures.

"The manual is divided into the following sections:

Part 1—Process Equipment

Part 2—Electrical Equipment

(Under electrical equipment a certain amount of discussion is devoted to the care of prime movers and other mechanical equipment which because of their intimate connection with electrical generating equipment, it was felt necessary to discuss their inspection.)

Part 3—Instruments

Part 4—Fire Prevention Equipment.

"Under each section, the scope, organization, methods of inspection, determination of limits, methods of repair and miscellaneous items will be taken up in their respective order.

"It is not the intention that all recommendations called for need be carried out by one organization, but can be handled by several. The organizations set up should be such as appear to the management of the individual companies to best fit their needs."

---

***First Instalment***

# P.A.W. Refinery Inspection Manual

## *Part 1—Process Equipment*

### *SECTION 1—Scope*

#### 111. General Statement

Part I of this manual covers suggested good practices for the organization of inspection personnel, methods and application of inspection to refinery process equipment, frequency of inspection, equipment requiring inspection, and suggested methods of determining retiring limits for various equipment and parts thereof. The primary purpose is to include only equipment, the failure of which would jeopardize safety of personnel or affect continuity of operation.

#### 112. Equipment Requiring Inspection

**112.01—Types.** An oil refinery contains heating elements, pressure vessels including all types of fractionating equipment, heat-exchange equipment, pumping machinery, piping and transfer lines, refrigeration equipment, storage tanks and various safety devices protecting this equipment from excessive pressures, all of which require inspection in varying degrees of frequency. In addition, there is auxiliary equipment used for the generation of steam or power, water systems including treating facilities and disposal of water wastes.

There also are included tanks and accumulators at the point of introduction of oil. Included also are all gas lines, stabilizing and sweetening systems for finished products, and equipment used for transferring all materials to points of storage together with the lines and tanks used for storage. In addition to the apparatus mentioned, water systems, gas collecting and distributing systems, service steam lines, transfer lines to and from working and storage tanks may require inspection.

It is impossible in a manual of this scope to enumerate the individual types of refinery operating equipment that may require regular inspection, but the general items mentioned above are those common to most refineries and of greatest importance. The inspector should, however, study each and every piece of apparatus in the refinery with respect to special conditions peculiar to a particular plant.

**112.02—Parts to be Inspected.** The determination of the parts of the refinery equipment which require the most careful inspection depends largely on the type of stock handled, the temperature, pressure and other general operating conditions to which the equipment is subjected. The inspector should familiarize himself with the detailed operating conditions for each particlar unit, and each piece of equipment making up the unit, carefully studying the causes of deterioration that may result from its operation.

**112.03—Functions of Inspectors.** The special jurisdiction of the inspection department is the analysis of conditions of all types of vessels containing oil or oil vapors, gases, air, acid, and various chemicals, together with pipes, valves and fittings connected to and interconnecting such vessels, whether such apparatus operates under vacuum, low or high pressure, and at low or high temperature.

**112.04—Limitation of Inspections.** It is not intended to include general mechanical adjustments in the scope of this manual. The inspection of machinery and auxiliaries should be a joint function of the inspection and maintenance departments and such apparatus should not be considered under the sole jurisdiction of the inspection department. Where special considerations, such as corrosion, require analysis the inspection department should assume responsibility for such analysis and subsequent recommendations.

#### 113. Frequency of Inspection

**113.01—Factors Governing Frequency.** There are many factors which govern the frequency of inspection of any specific apparatus, but the principal considerations are pressure, temperature, corrosive action of the mediums handled, the materials of construction with special regard to corrosion resistance of those materials and the additional thickness provided as a corrosion allowance.

It is generally recognized that the

type of charging stock processed governs, to a large extent, the corrosive products formed at various temperatures and an analysis of samples will indicate, in a general way, corrosive elements present. The medium handled and design of apparatus should be carefully studied to determine the inspection cycle on heater elements, process lines, pressure storage tanks, vessels and exchanger apparatus.

When a unit has been in service a year or longer and inspected at regular intervals, the inspection records, if kept in proper form, will disclose what parts need most frequent inspection and what parts can be safely inspected at longer intervals.

**113.02—Scheduling.** It is recommended that all apparatus within the battery limits of process units be inspected in accordance with a predetermined schedule which should not exceed the time limitation set fourth in the API-ASME Code for Unfired Pressure Vessels. General yard service piping and storage tanks may require inspection at less frequent intervals, except where known special conditions warrant close attention. The determination of the interval between inspections of equipment, as described in Section 4 of Part 1, depends on rate of deterioration and severity of operations.

In considering these inspection intervals, it should be borne in mind that all pressure vessels and their safety relieving devices should be inspected at least as often as set forth in Section 1 of the API-ASME "Code for Unfired Pressure Vessels." It is suggested that each refinery have available, for ready reference, a detailed inspection schedule covering its equipment.

**113.03—Partial Inspections.** The inspection of a processing unit should be thorough from the point of admission of charging stock through to the completely manufactured product. Due to limitation of time, it frequently is not feasible to inspect completely and obtain records on each particular piece of apparatus in a processing unit at one time. For the sake of convenience on complicated systems, inspection can be conducted on one section of the unit at one shutdown period and, on the balance of the system at later intervals.

**113.04—Design or Operation Changes.** Each element should be inspected at regular intervals. Partial or spot inspections should be made at each shutdown period on apparatus known to be subject to severe corrosion. Time limits of inspection intervals may change as maintenance requires replacement of one type of material with a different type. The inspection department should be advised of changes in designs or operations so that an estimate may be made of the frequency with which detailed inspection is necessary.

**113.05—Summary.** The remarks in the preceding paragraphs are of necessity of a general nature and intended to provide a basis of analyzing particular problems which may exist in those portions of a process unit which generally are regarded as the most hazardous.

Parts such as tubes and headers of a furnace, pumping equipment, safety valves, piping, fittings and operating valves throughout the system, heat exchanger apparatus, pressure tanks and pressure vessels should be carefully checked at frequent intervals.

The same general remarks will apply, in a lesser degree, to the structural elements of furnaces and stacks, to the various portions of chemical tanks and transfer lines, refrigeration units, centrifuge units, compressors, and various apparatus in agitating and treating systems.

## SECTION 2—Organization

### 121. Responsibility for Inspection

**121.01—Delegation of Responsibility.** The refinery management should delegate to a qualified person the responsibility for inspection and testing work. He should be solely responsible to the refinery management for all inspection activities. In the case of large plants, an inspection department may involve several men headed by a chief inspector, while in the small plants the man designated as chief inspector may have other duties to perform.

**121.02—Procedure.** The inspector should execute his duties in accordance with some definite outline of procedure. Suggestions for inspection procedure are contained herein, but should be modified as individual circumstances may require.

**121.03—Reporting.** At the completion of each inspection he should advise the plant management of the necessary repairs, replacements or safety measures which have been made or which should be made at some specified date.

**121.04—Cooperation with Other Departments.** It is recommended that the responsibility delegated to the inspector be concerned not only with physical inspection and reporting thereon, but further he may well carry out his duties so as to be of aid to the maintenance and operating departments in the conduct of their activities. In addition to this, the chief inspector may make recommendations to the plant management in predicting major replacements, improvements in design, preparation of budgets, and similar matters.

**121.05—Summary.** The fundamental duty of the inspector is responsibility for disclosure of the physical conditions of all equipment and keeping accurate records thereon. A secondary duty is cooperation with other departments in planning operating schedules.

### 122. Qualifications For Inspection Supervisors

The inspection supervisors should have qualifications similar to the requirement of Section 1 paragraph 201 of the API-ASME "Code for Unfired Pressure Vessels." It is suggested that these qualifications be as follows: Inspection supervisors be not less than 25 years of age and have not less than five years' experience in the design, construction, maintenance, and/or repair, or in the responsible supervision of the construction, maintenance, and/or repair of various types of refinery equipment, including at least one year of experience in the inspection or supervision of inspection of cracking units. In addition it is urged that preference be given to engineering graduates with a suitable technical training in this or kindred fields.

### 123. Relation to Other Departments

**123.01—General.** Petroleum refinery managements should fully appreciate the importance of setting up and maintaining proper relationship between the inspection group and other interested company departments. The functions of an inspection group should be such that the management can be assured that equipment is being maintained in a safe manner, that off-stream time is reduced to a minimum by anticipation of necessary repairs and that new equipment can be selected with intelligence as a result of records of past operating experiences. This group may also perform inspections of fabrication and erection of new equipment.

**123.02 — Work Authorization.** It cannot be too strongly emphasized that before any repairs or replacements suggested by the Inspection Department are undertaken, the inspection, operating and safety departments should be in complete agreement as to the procedure. The

**How to Secure Reprints of Refinery Inspection Manual**

Reprints of the complete PAW manual on refinery inspection recommendations will be made available to oil companies for distribution through their plants, as the articles appear in the NPN Technical Section.

Separate reprints will be made for each of the four sections of the manual, on Processing Equipment, Electrical Equipment, Instruments and Fire Protection Equipment, as soon as the text of the complete section appears in article form. Reprints of individual articles in the series can also be supplied as they appear.

For prices on reprints write Editorial Department, Technical Section, National Petroleum News, Cleveland.

authorization for the work should be in writing and bear the signature of a duly authorized person designated by management. Unless some such arrangement is adhered to it is inevitable that misunderstandings and confusion would result with subsequent loss of on stream production time of the unit.

**123.03—Provisions for Future Inspection of New Equipment.** The inspection group needs and merits established relations with other departments of the company. Provisions made for the chief inspector or inspection supervisor to review drawings of proposed installations before erection will be helpful. Means for access to vessels, the proper location and number of manways, internal ladders, flanges, etc., can then be provided in advance of erection.

During construction, the inspector should be permitted the opportunity to locate bench marks, determine original dimensions, thicknesses, etc. This work will require cooperation between the engineering, construction and purchasing departments.

**123.04—Independent Position of Inspection Groups.** Usually it is desirable for the local refinery management or superintendent to be entirely responsible for the safe operation of the plant. In this case, the inspection organization is a service group only, with the responsibility of keeping the operating department fully informed as to the condition of the equipment.

It is suggested, however, that the inspection group report direct to the local refinery management and not be under the control of persons directly concerned with operation. This tends to eliminate the possibility of safety being sacrificed for production.

**123.05—Use of Proper Specifications.** The inspection group should collaborate in the ordering of replacement stocks and review the materials specified so that performance data can be taken into consideration.

**123.06 — Process Changes.** The inspection department should be consulted when changes in processing are to be made to determine if the equipment is suitable for increased temperatures and pressures or for running a different type of feed stock.

**123.07—Cooperation with Operating Personnel.** It is often advisable to have unit operators work with the inspection group during a shutdown. This tends to develop closer cooperation between the two groups. The inspector thus could be informed of all operating peculiarities during the previous run, enabling his inspection to be more direct. Also, the operator becomes more familiar with the inside of the equipment.

**123.08—Laboratory Facilities.** The inspection group should have access to metallurgical and chemical laboratory facilities. While the physical inspections and repairs are largely of a mechanical nature, the prevention of corrision, the largest single cause of deterioration in an oil refinery, often requires the advice of trained chemists and metallurgists.

**123.09—Additional Labor.** When a unit is off-stream for inspection, the inspector will need the assistance of mechanics, carpenters, pipefitters, electricians and a number of laborers for cleaning and as general helpers. This crew can best be recruited from the refinery mechanical department.

**123.10—Preliminary Planning.** It is desirable to have the inspection group issue an "Inspection Outline" prior to the shutdown of any unit. The inspection outline should list as much of the necessary work to be done during the shutdown as can be determined from past performance, enabling advanced planning by all departments concerned.

This will permit the inspection work to be coordinated with other turnaround operations so that delay in returning the unit to production can be eliminated. Longer off-stream periods can be planned for the major inspections after the units are well ahead on production schedules.

To avoid misunderstandings concerning equipment considered unsafe, it may be found advisable to have the inspectors submit written recommendations for repairs and replacements to the main-

## REFINERY ORGANIZATION CHARTS PROVIDING

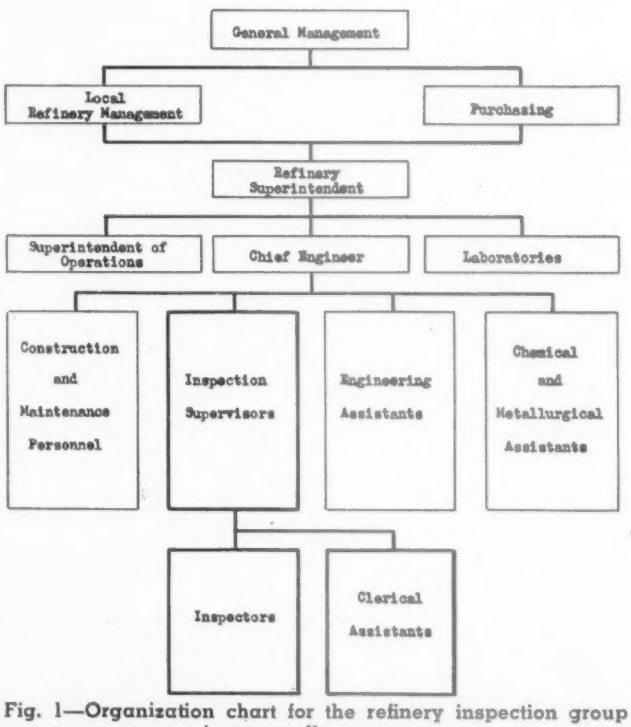
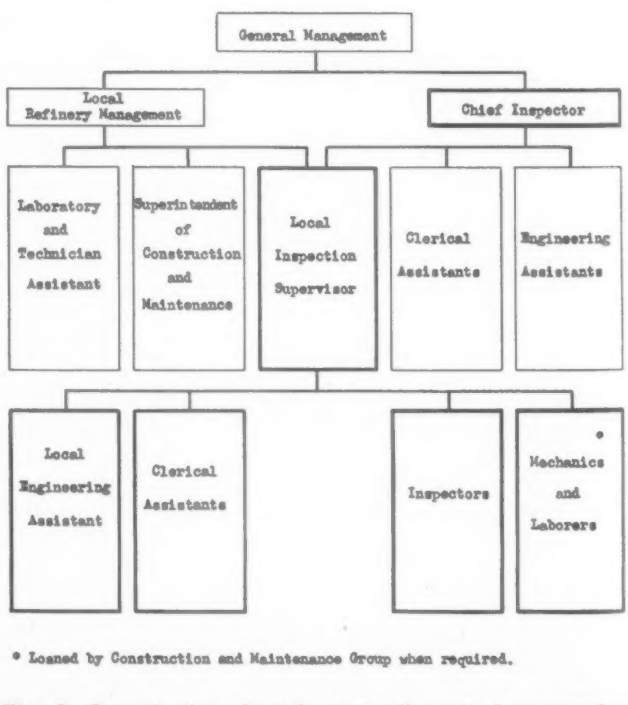



Fig. 1—Organization chart for the refinery inspection group in a small company




* Loaned by Construction and Maintenance Group when required.

Fig. 2—Organization chart for a medium-sized corporation with closely grouped plants

tenance and operating departments, so that work or purchase orders may be issued to cover such work.

**124. Suggested Organization Charts.**

**124.01—Outlines of Organization.** Many forms of organization are possible to achieve the same results. The four organization charts presented in Figs, 1, 2, 3, and 4, are merely suggestive and have the coordination of various departments, as discussed above, incorporated in them. While these charts cover some typical organizations, other variations might be employed, as long as there is an individual responsible for the inspection work and provision is made to give him ample backing in the performance of his duties.

**125. Duties—Chief Inspector**

**125.01—General.** The actual duties of a chief inspector may include functions not mentioned below or he may not perform all of those mentioned. Allocation of work being strictly a managerial function, the actual duties of the chief inspector and work to be performed by him will vary considerably in various organizations.

**125.02—Primary Duties.** The chief inspector's duties would generally include the following items:

Supervision of the inspection of all refinery equipment.

Recommend abandonment of all equipment unsafe for service.

Recommend repairs required to place equipment in safe operating condition.

Recommend methods by which repairs might be made.

Supervise inspection after repairs are complete.

Familiarize himself with various process operations so that he can calculate retiring thicknesses for all equipment and recommend changes which might be made to increase the equipment life without interfering with the operation.

Study all inspection reports made out by the inspectors with the idea of forecasting retirement dates and recommending the use of alloy or special materials to increase the life of the equipment.

Determine the frequency of inspections for the various equipment.

Study failures of unusual nature and suggest changes, repairs or replacements to prevent recurring failures.

**125.03—Auxiliary Duties.** If the chief inspector is also responsible for inspection of shop work and shop field welding, his duties might include the following items in addition to those mentioned above:

Ascertain that all new construction or maintenance work meets the requirements of the applicable code.

Supervise inspection of all layout work, welding, stress relieving, testing, etc.

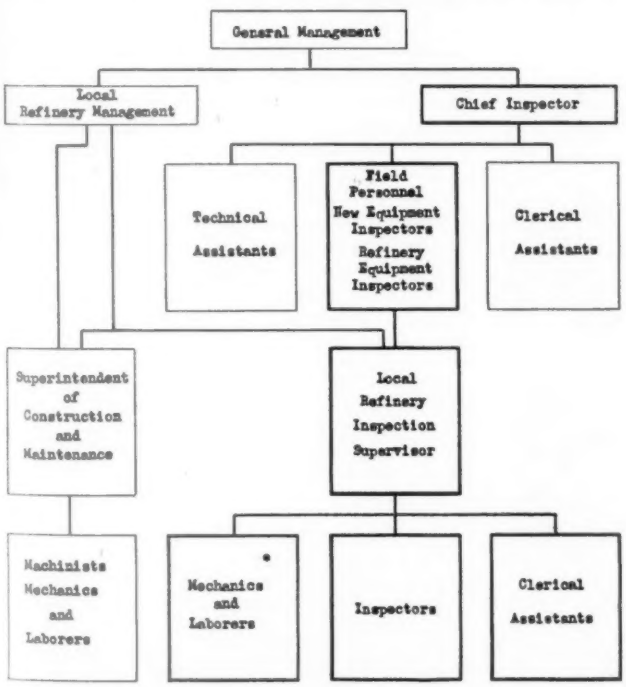
Supervise the testing of new welders and the retesting of all welders.

(NOTE: The paragraph numbers used in the PAW Manual indicate, from left to right, the following: the first digit is the part number; second digit is the section number; third and (if there is one) fourth digits are topic number under the section; numbers to the right of the decimal point are paragraph numbers under a given topic; a letter suffix indicates a subparagraph, i.e. 142.01(a), 2310.04(b).)

### Next Month

The Second Instalment of the PAW Refinery Inspection Manual, continuing Part 1 of the manual, Refinery Process Equipment, will appear in the August 1st NPN Technical Section. This instalment will present Section 3—Methods of Inspection and Their Application, and will include Unfired Pressure Vessel; Shell and Tube Equipment; Box Type Coolers; Pipes, Valves and Fittings; Furnace Tubes; Headers; Furnaces and Fire Boxes; Thermometer and Thermocouple Wells; Safety or Relief Valves; Supports, Walks, Stairways and Platforms; Tanks; and Other Equipment.

## FOR INSPECTION OF PROCESSING EQUIPMENT




* Loaned by Construction and Maintenance Group when required.

Fig. 3—Organization chart for a centralized large corporation with many scattered plants

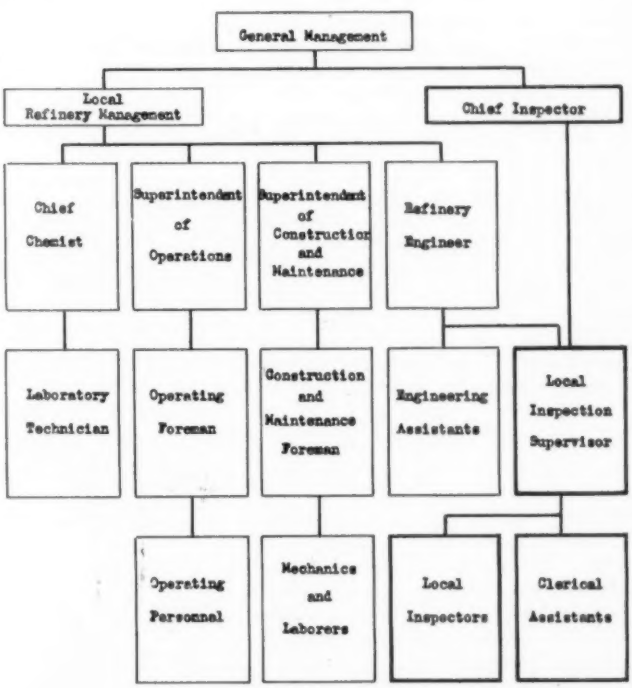



Fig. 4—Organization chart for a centralized large corporation with many plants

# Patent Trends in Petroleum Refining

*By Peter J. Gaylor*

**To keep its readers informed of developments in new and improved refining processes, NPN's Technical Section has arranged with a leading authority to screen current patents and review those of importance to petroleum refiners in a regular feature, "Patent Trends in Petroleum Refining." U. S. patents will be reviewed as issued and foreign patents as soon as data becomes available in the published literature.**

**This service will be especially important to readers at present, since information will be forthcoming on new patents issued but held under secrecy orders during the war period.**

**The author of this new regular feature of NPN's Technical Section is Peter J. Gaylor, patent attorney and editor of the Technical Survey, Newark, N. J.**

## *Foaming of Lubricating Oils*

World War II had not progressed very far when oil suppliers became besieged with complaints of aviation oil foaming. It was not an uncommon sight for a pilot to see foam blobs all over a plane flying at high altitude. Many of the difficulties were encountered with oils containing additives and this effect tended to retard additive development to some extent. Fortunately, the problem has been solved to a degree such that foaming is not now considered a serious flying hazard.

In one article on additives, Kalichevsky disclosed that silicon compounds are employed for this purpose. For this reason, attention should be directed to Shell Oil Co.'s recent patent 2,375,007 covering the use of a small amount (less than 0.1%) of polymerized dihydrocarbon silicones and hydrocarbon silicates as active defoaming compounds. Polysilicones have already received much publicity as high temperature insulation coatings.

The mechanism of foaming is not yet completely understood, although studies[1] are throwing more light on the matter. One apparent fact is that the defoaming agent must be insoluble. It can be a solid such as montan or carnauba wax[2], or ketone of at least 11 C[3], or a liquid, e.g. an alcohol of 8-20 C[4], high boiling fatty or mineral oil[5], etc.

Apparently the foaming ingredient is concentrated on the surface of the bubble, and the defoamer acts as an adsorbent or solvent, thereby preventing the foaming agent from lowering appreciably the surface tension of the bubble materials. In the case of "pure" materials which foam, minute amounts of oxidation products or other impurities may be responsible.

Advantage is taken of the fact that the foam phase has a different composition from the liquid phase in some patents issued to Eastman Kodak[6] which disclose a method of separation by foaming a mixture and removing the foam continuously, the latter being richer in the component desired. This "*foam fractionation*" technique might be applicable to the separation of high-boiling, heat-sensitive compounds which will not stand the severe conditions of conventional separation methods.


**References**

1) Ambrose et al, *National Petroleum News* 5/2/45, p. R-379.
2) U. S. 2,230,556 (S.O.D.)
3) U. S. 2,363,921-4 (Dearborn Chemical Co.)
4) U. S. 2,294,145 (S.O.D.)
5) U. S. 2,373,951 (Shell)
6) Br. Appl. 27,886/30; Can. 423,342.


## *Vapor Phase Extraction*

One development which has been progressing rapidly in recent years, but which has not received any degree of publicity, is vapor phase extraction, or *extractive distillation*. It involves the contacting, during fractionation, of the vapor phase by a high boiling selective solvent which is removed as fat liquor at the bottom of the tower. This differs from *azeotropic distillation* in which the selective solvent is removed overhead as an azeotrope with the purified product.

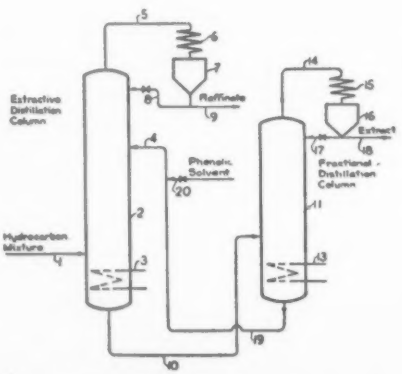



**Fig. 1—Typical flow diagram of extractive distillation processes**

That the process is already in the commercial stage is indicated by Shell Oil Co.'s advertisement last year[1] mentioning the availability of such a method for obtaining pure benzol. Several recent Shell patents (2,375,035-6) disclose the production of pure butadiene by the use of phenolic solvents. In order to reduce the tendency of the two to react with each other, a small amount of phenolate or amine is added with the solvent.

Fig. 1 is typical of extractive distillation processes in general. The mixture containing the ingredient to be extracted is fed at (1) into distillation column (2), and the vapors are contacted countercurrently with the higher boiling solvent (20) fed in at a higher point in the column (4). The fat liquor (solvent plus extracted component) is drawn off at the *bottom* of the tower (10), and fed into a stripping column (11) which takes overhead the extracted component. The solvent is then drawn off the bottom (19) and recycled to the extraction tower (2) . One limitation of this method is that a narrow feed cut should be used in order to obtain an extract of high purity.

A number of companies have been working on the development and a number of patents have already been obtained[2], Standard Oil Co.'s (Indiana) 2,168,691 discloses the extraction of narrow cut gasoline with polar compounds to produce concentrated antiknock hydrocarbons. Standard of California has likewise obtained a number of patents disclosing resorcinol as the most selective solvent for aromatics and unsaturates. To eliminate foaming, Shell adds a small amount of mineral or fatty oil (over 75 vis./100°F.) boiling above the mixture treated and insoluble in the fat solvent (2,373,951).

The process has potentialities in the production of pure materials such as toluene, styrene, pure naphthenes, and olefins. No doubt further developments will be disclosed as soon as war secrecy is abolished.


**References**

1) *Oil & Gas J.* 4/1/43 p. 70.
2) U. S. 2,123,642 (S.O.D.)
U. S. 2,134,241 (Susselbeck)
U. S. 2,215,915 (S.O. Calif.)
U. S. 2,168,570 (Lummus)
U. S. 1,866,800 (Shell)
U. S. 1,948,777 (Carbide)
U. S. 2,096,871 (Atkins)
U. S. 2,167,730 (Lummus)
U. S. 2,109,157 (Shell)
U. S. 2,076,519 (S.O.D.)
U. S. 2,257,283 (S.O. Calif.)
Br. 324,350 (I.G.)

# New Methods of Fighting Oil Fires Are Given Full-Scale Tests in 93-Ft. Tank

## Effectiveness of Mechanical Foam and of Water Spray Are Demonstrated in Four-Day Experiments on 32,000-Bbl. Storage Reservoir at Oil Company's Tank Farm

*By William F. Bland*
Engineering Editor, NPN Technical Section

TO DETERMINE the effectiveness of new methods of fire protection on oil storage tanks, Standard Oil Co. (Ohio) recently sponsored a four-day series of full-scale fire fighting tests at its Moorhead tank farm, near Findlay, O.

All the tests were carried out in a 93-ft. diameter storage tank, open at the top and partly filled with crude oil which was repeatedly lighted, allowed to burn freely for from three to 7.5 minutes, and then extinguished.

Both mechanical foam and water spray were tested as extinguishing agents, with each material being supplied through fixed equipment attached to the tank. Fixed equipment has been used for years with chemical foam, but no commercial installations have been made in this country for the application of mechanical foam to storage tanks, according to engineers participating in the tests.

These tests, held April 30 through May 3, are reportedly the first attempted in this country on such a large scale. They were sponsored by Sohio with the cooperation of three leading manufacturers of fire-fighting equipment—Automatic Sprinkler Corp. of America, Youngstown, O.; Pyrene Development Corp., Newark, N. J., and National Foam Systems, Inc., Philadelphia.

Widespread interest was shown in the tests, with top executive and military personnel throughout the country coming to Findlay to make first-hand observations. Among more than 250 persons witnessing them were representatives of the Army, Navy, Coast Guard, refineries, insurance companies and municipal fire departments.

All of the tests were under the direction of R. T. Henderson, Sohio's safety engineer.

The first day's tests were devoted to water spray equipment. Automatic Sprinkler Corp. had installed a system of spray nozzles in the test tank, the nozzles being spaced 10 ft. apart and 10 ft. above the bottom of the tank.

Operation of the spray system was entirely automatic, controlled by a heat-activated device which opened a deluge valve whenever the temperature in the area being protected rose too rapidly.

The principle behind Automatic's tests was to control the fire and keep it at a low temperature until the light ends had been burned off. Top temperatures recorded were 110°F. during the first test and 260°F. in the second test.

Following the water spray tests, mechanical foam was tested, first by Pyrene and later by National Foam.

Mechanical foam is a relatively new method of fire control in this country, although chemical foam has been used in refineries for many years. The Sohio tests were particularly valuable because they afforded an opportunity for full-scale use of fixed applicators for mechanical foam, which are still in the experimental stage.

"For some time we have been interested in mechanical foam for fire protection in oil properties," explained Mr. Henderson. "When it came to the actual installation of equipment on large tanks, however, we always hit the same complaint: 'No way that these materials could be tested out under large-scale conditions.' "

The Sohio tests were designed to simulate just such conditions.

In chemical foam two chemicals are mixed at the point where the foam is to be applied, the resulting reaction producing carbon dioxide. A foaming agent, present in the mixture, causes the carbon dioxide to become trapped in small bubbles of frothy foam, very similar in appearance to fine soap suds. This foam, spread over a flaming oil tank or similar object, excludes all air and smothers the fire. In addition, the bubbles, when they burst, release the inert carbon dioxide, which has a further smothering effect.

Mechanical foam, on the other hand, uses only a single solution and depends entirely upon the smothering action of the foam. There is no chemical reaction, the ingredients being inert in both oil and water. The single solution, a foaming agent, is fed into the water stream at any point. Just prior to application this mixture of water and foaming agent passes through a foam maker, into which is drawn air. The mixture of water, air and foaming agent produces a foam not unlike the chemical foam in appearance, but described as tougher and more stable. When spread over a flaming area it has basically the same smothering effect as chemical foam.

One objection to a chemical foam installation is the need of two separate lines from a central foam house to every tank to be protected. A mechanical foam system requires only one line.

In the mechanical foam tests conducted by Pyrene the foaming agent and water were fed into the tank through

**This 93-ft. storage tank of flaming crude has been blazing for three minutes with no attempt to control the flames; 4 min., 2½ sec. later, after mechanical foam had been applied, the fire was entirely out**

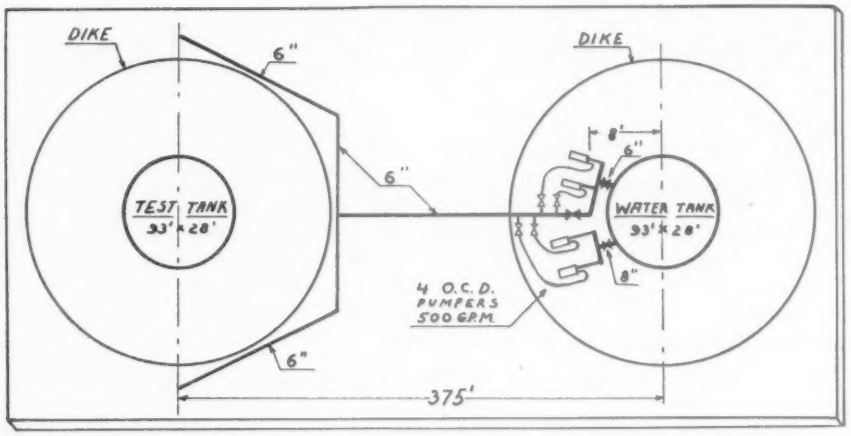



**Fig. 1—Diagrammatic sketch of the test and water tanks used in the Sohio fire tests**

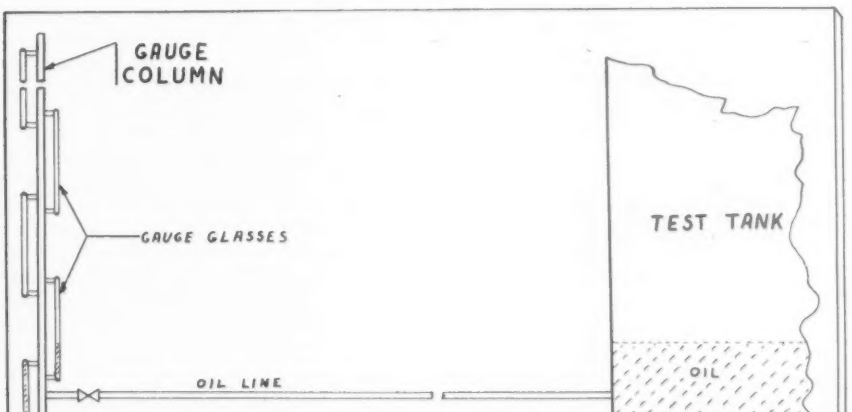



**Fig. 2—Gauge column for measuring water and oil levels in the test tank**

six 6-in. standpipes, spaced evenly around the tank. In the first of the Pyrene tests, the company's regular foam compound was used and all six discharge lines were employed.

In the company's second test, its special Navy foam compound was used with all other conditions remaining approximately the same. Later tests were carried out with only three and then two of the standpipes in operation to determine the minimum amount of foam required.

National's test, on the last day of the four-day series, was carried out with a similar type of mechanical foam, applied through two Moeller tubes in foam chambers located in the top ring and on opposite sides of the tank. Moeller tubes are loosely woven of asbestos-covered copper wire. They are designed to spread the foam gently on the surface of the burning oil, rather than shooting it down into the oil in a solid stream.

Mechanical difficulties with the test installation interefered with this test, however, so that the results, even though the fire was extinguished, were not actually comparable with the other tests.

Detailed descriptions of all of the tests are given later.

## Test Equipment

The 93-ft. diameter tank used for all of the tests was 26 ft. high and had a capacity of nearly 32,000 bbls. The tank had been abandoned as unfit for storage purposes and so was made available to the safety department for test work.

The roof and roof supports had been removed, leaving only the tank shell and bottom. The shell was of wrought iron plates, riveted.

Due to the age of the tank bottom, approximately 3 ft. of water bottom was used at the start of the tests. This water bottom increased as additional water was introduced into the tank during the extinguishment tests, and was subsequently pumped down to bring it back to the 3-ft. depth.

An interesting sidelight on the tests was the effect on the tank structure of the fires, which at times passed 2000°F. and burned as long as 43 minutes. An examination of the tank shell after the last test showed it to be in fair condition. All rivets were intact and tight, although the plates were warped in some locations. Oil sludge was burned out of the seams, which probably would cause oil seepage if the tank were used again for oil storage.

A bad leak developed, however, in the tank bottom. It was first noticed after the second day's tests. Earth was shoveled against the tank shell at that point and the leak was slowed. But during the last day of the tests the leak increased considerably. It is probable that the condition of the tank prior to the tests, rather than the fire, was responsible for the leak.

No water system is available at Sohio's Moorhead tank farm, so it was necessary to provide a second storage tank for a water supply. This tank was approximately 300 ft. from the test tank.

The water tank was also 93 ft. in diameter. It was 28 ft. high, had a capacity of 36,000 bbls., and contained 25,000 bbls. (1,050,000 gals.) of water prior to the first test.

Four 500 gpm OCD pumpers from the Office of Civilian Defense in Cleveland and Findlay were connected to the water tank and supplied water through a 6-in. line that extended halfway around the test tank outside of the firewall. Take-off valves were provided at various points on this main 6-in. supply line.

Pressures at the test tank ranged from 75 to 165 psi. A diagram of the two tanks is shown in Fig. 1.

The levels of the water and oil in the test tank were measured by a gauge column situated outside the firewall around the tank. This column consisted of a vertical section of 2-in. pipe about 12-ft. long with gauge glasses mounted on it to show liquid levels. The column was connected to the tank as shown in Fig. 2.

To operate the gauge column the 1-in. oil line was opened and oil admitted to the column. When the oil had reached its level, the 4-in. water line was opened and water entered the column, causing the excess oil to run back into the tank.

Oil used for the first test was fresh Illinois crude, approximately 33° API gravity. The analysis of this crude is given in Table 1.

**TABLE 1—Analysis of Illinois Crude Used in Sohio Fire Tests**

| | |
|---|---|
| API Gravity, °Be | 32.9 |
| I.B.P., °F. | 162 |
| 10%, °F. | 278 |
| 20%, °F. | 368 |
| 30%, °F. | 440 |
| 500°F., % | 38 |
| B.S. & Water, % | 0.5 |
| Water, % | 0.1 |
| Flash Point | Room Temp. |

About 200 bbls. of oil, representing a layer 2 in. thick, were in the tank for the first test. Additional quantities of fresh oil with the same analysis as that

(*Continued on pg. R-566*)

# A Workable Employe Suggestions Plan

**Program as Carried on Successfully for Several Years by One Large Oil Company Calls for Formal Procedures, Prompt Acknowledgment and Passing On Suggestions, and Awards to Originators of the Ideas Based on Estimated Savings Resulting from their Installation in Plant Operations.**

*By D. P. Thornton, Jr.*
*Assistant Editor,*
*NPN Technical Section*

CITIES Service Oil Co. has saved an estimated $182,123.82 in the last seven years through its Employe Suggestions Plan, for a total outlay in award money of $3770.38. If the savings were computed from 1926, when the plant first was placed in operation, the actual sum would be much larger but the significance of the figures would be the same Also, if the intangible value of many suggestions, such as those concerning safety, for example, could be actually concretely estimated, the savings would be still greater, including such benefits as the improved welfare of employes themselves.

The $182,000 figure is not considered disproportionate to the award total, even though it may seem out of line on first consideration. Awards to the employe are made on the basis of 10% of the first year's savings through adoption of the suggestion, while the saving is cumulative as long as the suggestion is in use. However, a supplemental award may be made to the employe if, after the suggestion has been in use for some time, it is believed to warrant more than the original award.

Last year, to stimulate the flow of suggestions, prizes totaling $350 were paid for the three best suggestions of 1944. This added incentive is still showing results, in that the number of suggestions received thus far in 1945 already exceeds the total number submitted for the first six months of 1944. Table 1 gives the results of seven years' experience of this company with its program.

### Plan Has Four Aims

The Cities Service Employe Suggestions Plan is set up with the following four primary purposes in mind:

**(1) To encourage each employe to advance such suggestions affecting company operations as he may conceive and to assure that he receives proper credit for his efforts.**

**(2) To pay the employe for his "labor" in doing work outside his line of duty.**

**(3) To reduce waste, increase production and safety in company operations.**

**(4) To promote the largest possible yield of suggestions, thus improving the statistical chance for the appearance of the relatively few suggestions promising exceedingly high savings value.**

As originally set up, each division of the company had its own suggestions committee to handle all submissions made by personnel of that division. This proved unsatisfactory for two reasons. In the first place, a suggestion might not only prove advantageous for the particular division where it originated but might also be applicable in other company operations. Second, the awards made by one division were not always "in line" with those made by some other division, even though the suggestions were of equal value.

To eliminate the disparity in awards, the program was changed to provide for the division suggestions committee recommending an award to the company budget committee, and this latter committee determined what sum was to be paid the employe making the suggestion. This still did not entirely eliminate the objection that a given division—or the budget committee—would fail to recognize a suggestion's wider applicability in company operations. It was then decided to use the present setup of a single committee covering company-wide operations.

### Committee Supervises Operations

The plan functions under the supervision of a four-man committee, composed of representatives of management, operations, technology, and the employes (public relations department). Appointments to the committee are made by the president of Cities Service Oil Co. One of the representatives is designated secretary of the committee and is made responsible for the mechanics of administration. Generally he is a member of the public relations department.

There are no set qualifications for membership on the committee. It is essential, however, that its personnel be such that each suggestion can be considered in light of company policies, operating conditions and technical requirements to put the suggestion into effect. Also, the entire Employe Suggestions Plan must be handled in such manner that it enhances employe morale. The committee meets at least once every 30 days.

At all times the committee must consider its actions in the light of their interpretation by the employes. Also the employes must be continuously urged to submit ideas by appropriate publicity. For these two reasons personnel department representation on the Suggestions Committee is particularly important. At Cities Service, the Public Relations Department is in charge of employe publicity and functions as the personnel department also. Publicity is handled by posters, articles in the employes' publication, *The Empire*, (a list of awards is printed therein each month), word-of-mouth encouragement by superiors and by paycheck inserts.

### Operational Policies

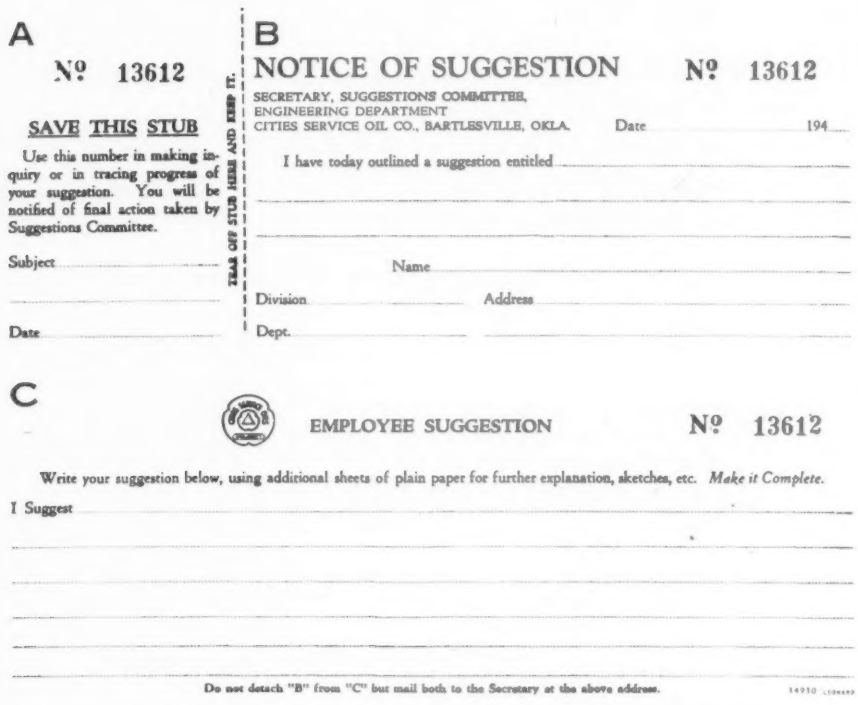
As a result of 19 years' experience with a suggestions program, the committee has set up a number of specific policies. Those of general application include:

All suggestions should be mailed directly to the Suggestions Committee secretary. There is no need for clearance "through channels," which eliminates the theoretical possibility of an immediate superior appropriating an idea for submission as his own, or worse, "killing" an idea because he did not think of it first.

All ideas, once submitted, are kept entirely anonymous until the time of award. Suggestions are submitted on a set form, to which there are three parts all bearing the same serial number (See Fig. 1). Part "A" is kept by the employe as a receipt. Part "B" is detached by the secretary at the time of receipt. It bears identification of the idea and identity of the employe submitting it. Part "C" gives the idea in full, additional pages being used if necessary for further explanation or sketches. Part "C" does not, however, give any clue to the identity of the employe making the submission. The reverse side of this form outlines the many

### *Another Suggestion System*

In view of the widespread interest in employe suggestion programs around refineries, NPN's Technical Section is presently studying another oil company's plan. An article describing the salient features of this program (which has been in operation over a decade) and its accomplishments will be presented in a following issue of the TECHNICAL SECTION.



A

Nº 13612

SAVE THIS STUB

Use this number in making inquiry or in tracing progress of your suggestion. You will be notified of final action taken by Suggestions Committee.

Subject .....

Date .....

TEAR OFF STUB HERE AND KEEP IT.

B

NOTICE OF SUGGESTION Nº 13612

SECRETARY, SUGGESTIONS COMMITTEE,
ENGINEERING DEPARTMENT
CITIES SERVICE OIL CO., BARTLESVILLE, OKLA. Date ..... 194..

I have today outlined a suggestion entitled .....

Name .....

Division ..... Address .....

Dept. .....

C

EMPLOYEE SUGGESTION Nº 13612

Write your suggestion below, using additional sheets of plain paper for further explanation, sketches, etc. *Make it Complete.*

I Suggest .....

Do not detach "B" from "C" but mail both to the Secretary at the above address.

**Fig. 1—Form to be filled out by Cities Service employes in submitting suggestions. Part "A" is employe's receipt, part "B" briefs suggestion and serves as identification in the Suggestions Committee files and part "C" is the actual suggestion**

kinds of suggestions which employes may turn in. (*See Fig. 2*)

All suggestions submitted are promptly acknowledged by the Suggestions Committee secretary on an official acknowledgment form, which carries a file number. The employe is told he will be advised in due course as to whether or not his suggestion can be used and he is asked to use the file number in making further inquiries or correspondence relative to his suggestion.

Time is decidedly of the essence in handling a suggestion. It must be adequately investigated, but the time between submission and receipt of award must be kept as short as possible. At least once a month after receipt of a suggestion, the individual submitting it is advised of its progress, so he will know it has not been forgotten. If possible, an initial award is made within a month.

In the event a suggestion is unacceptable, the submitter must be advised promptly and in detail just why his suggestion was not usable. At the same time, he must be encouraged to revise his idea or to submit another one. For psychological reasons, the secretary of the committee advises of the rejection, tells specifically why, and signs the letter personally.

Every suggestion is considered as acceptable if the answer "yes" can be made to the following questions: (1) Is it original with the man? (2) Has he suggested something of value to the company? (3) Has the employe received all the recognition he should have? (He always must get the benefit of any doubt).

Awards are made on the basis of 10% of the estimated annual saving due to its use. If later it is apparent that the estimate was low, then a supplemental award is made to assure that the man gets his actual 10% of the saving. For suggestions like those pertaining to safety, any determination of value, usually being intangible, must be based solely on judgment. A minimum value of $1 is formally set for awards, but in recent years the practical minimum has been $5. There is no "ceiling" for awards; some have been as high as several hundred dollars.

Awards are considered as employe income, and corresponding deductions are made from the recipient's pay for withholding and social security benefits. Actual payment, however, is in the form of War Bonds or Stamps. If the amount awarded is *below* but *near* the purchase price of a Series E Bond, the appropriate bond is awarded; if not, the difference is made up by War Stamps.

If the suggestion is patentable, the company generally permits the employe to patent it if requested in writing. A royalty-free license to use it is retained by the company in such cases.

There are no restrictions on the frequency with which an employe may submit ideas. Any employe from president to day laborer may submit a suggestion. However, a supervisory employe will not receive an award unless his suggestion pertains to operations outside his line of duty. The suggestions program is maintained primarily for non-supervisory employes; employes below the grade of foreman or farm boss, for example.

**Operational Mechanics**

Initial operation of the plan is for the employe to submit his idea to the Suggestions Committee on the appropriate form (Figs. 1 and 2). The Committee secretary acknowledges receipt of suggestion then assigns it a file number and marks the number of Parts "B" and "C". The suggestion, Part "C" of the form and including any additional sheets, then is sent to the manager of the division to which the suggestion pertains for investigation and recommendation. The division manager in turn may refer it to one or more of his assistants.

Following the plan of keeping the procedure for handling suggestions as formal as possible, the division manager, referring to the suggestion by file number, reports to the Suggestions Committee on a printed form. The form provides space for stating the reason why the particular suggestion should be adopted, or not adopted. If it is to be adopted the report must show the estimated savings and how these savings were calculated; the cost of installation of

# WHAT TO SUGGEST

All employees are invited to submit practical ideas for the saving of time, labor, materials or money in any form, or for any kind of improvement in the work, products or services of this company, or to increase safety.

Tell us how to

## *Increase Production*

*—by improving quality of work*
*—by improving products*
*—new products*
*—by improving manufacturing and office methods.*

Can we improve service to customers?
Can we handle our work better and quicker?
How can we improve our equipment?

Tell us how to

## *Reduce Waste*

*—of time*
*—of Material*
*—of effort.*

Can we use material now being scrapped?
Can we eliminate unnecessary blank forms?
Can we use less costly tools and material and get same results?

Tell us how to

## *Increase Safety*

*Point out danger spots.*
*Where do we need safety guards?*
*Send in new ideas on Safety First.*

**Think! Think! Think!**

**Fig. 2—Reverse side of suggestion form shown in Fig. 1**

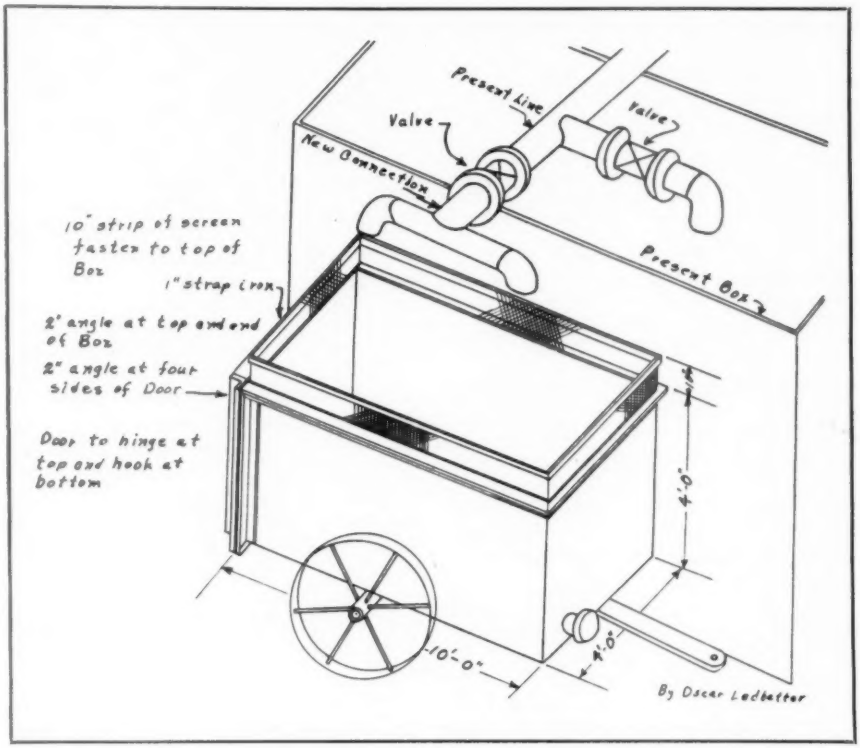



**Fig. 3—Tracing of employe's sketch of the idea awarded grand prize of $200 for being the best submitted in 1944. It is a dump truck to handle breeze coke and water from Dubbs units**

the suggestion in actual plant operations and where such installations are to be made; whether the suggestion can or cannot be applied to other divisions and, finally, a recommendation as to the amount of award to go to the employe submitting it.

As soon as the division manager's recommendation reaches the Suggestion Committee secretary it is presented at the next meeting of the committee. Here it may be accepted and amount of award determined, or rejected as unusable, or ordered held for further investigation.

The committee may order an award greater or lesser than recommended by the division manager, or accept a suggestion even if recommended for rejection. In the committee's decision, the suggestion is considered on the basis of company operations as a whole, to make sure that the division involved may not have overlooked additional applications.

As a case in point, a suggestion concerning an old compressor, located on some recently-acquired producing property, was turned down by the operating division involved. The old compressor, it seems, was in the habit of bending crankshafts regularly if not unloaded before stopping; more modern compressors used on other properties are self-protected against this mishap. But the employe solved the particular difficulty by installing an ingenious and simple modification of his own which accomplished the unloading and stopping automatically. Basis for recommendation for rejection by the operating division was that this problem is not encountered with compressors on other properties. The Suggestion Committee, however, reversed the rejection and made an award on the grounds the employe's suggestion would save money on at least that one compressor and his solution was original with him even though the idea was not practical with other more modern compressors.

When an award is made, the appropriate bond and stamps are forwarded to the manager of the division to which the employe is attached. He then writes the employe a commendatory letter and transmits the award therewith.

### Legal Aspects of Plan

The Cities Service Employe Suggestions plan is one of the earliest to be adopted in the oil industry; it is as old or older than some of the systems now being promoted commercially. As a result, when the wage stabilization order was issued, the plan was automatically included since it was a prior practice of the employer. However, when the prize award modification was approved by management, details were submitted to the War Labor Board and the Salary Stabilization Unit of the Bureau of Internal Revenue for their approval. In the case of companies contemplating a similar plan, it is suggested that these agencies' approval be obtained before the system is placed in operation.

Awards for suggestions are considered additional income to the employe, hence are subject to withholding and social security levies. These deductions are added to those ordinarily made each pay period against the employe's pay check for the pay period in which the award is made. While this temporarily throws the gross pay into a higher withholding bracket, the award actually is in War Bonds. Therefore, if the employe holds the bond for the full 10-year period of maturity he actually will net back the full amount of his award plus the additional amount withheld from his check and still have a bit more as "interest."

No set policy can be developed towards patentability of an idea or suggestion; such cases are handled individually. Cities Service takes the attitude that it is not interested in patenting "gadgets" although it may wish to make use of them in company operations. If the employe wishes to patent an idea the company will generally give him a complete release upon request, retaining only the right to use the idea in its own operations on a royalty-free basis. Employes engaged primarily in research are restricted from patenting their ideas by their contracts of employment; if the patentable idea is not in their line of duty, however, it is probable there would be no difficulty in securing a release upon request.

### Plan in Action

Better to illustrate the mechanics of the program in action, and to give an example of the value of some suggestions, the suggestion awarded first prize of $200 for being the best submitted in 1944 is given in the detail in which the originator

**Oscar Ledbetter, who made the 1944 prize-winning suggestion in Cities Service's employe suggestions plan and his idea as worked out, a dump truck for Dubbs stills**

TABLE 1—Seven Years' Experience, Cities Service Employe Suggestions Plan

| Year | 1938 | 1939 | 1940 | 1941 | 1942 | 1943 | 1944 | Seven Year Average |
|---|---|---|---|---|---|---|---|---|
| Suggestions Accepted, % of total submitted* | 33.6 | 32.1 | 47.1 | 46.3 | 46.5 | 48.0 | 39.0 | 41.82 |
| Gross Amount Awarded, Including Supplementals, $* | 92.00 | 214.50 | 475.80 | 909.18 | 613.10 | 482.15 | 983.65 | 2,386.26 |
| Cash Value of Average Initial Award, $* | 3.70 | 8.50 | 15.85 | 5.00 | 34.65 | 17.10 | 15.38 | 14.31 |
| Gross Amount, Supplemental Awards Granted for Suggestions Made in Previous Year, $* | 0.00 | 0.00 | 0.00 | 764.48 | 59.00 | 122.60 | 183.75 | 282.46*** |
| Calculated Savings Earned by Suggestions Installed $** | 2,050.00 | 1,393.60 | 19,513.63 | 8,558.16 | 7,394.40 | 901.95 | 3,624.33 | 6,205.15 |
| Cumulative Savings from Suggestions, $*** | 2,050.00 | 5,493.60 | 28,450.83 | 59,966.22 | 98,876.01 | 138,687.75 | 182,123.82 | 26,017.68 |

*Includes awards for safety suggestions.

**Intangible savings, such as those accruing from safety suggestions, are not included.

***Average for four years only.

presented it and the recommendation made by the division affected.

Oscar Ledbetter is employed in the yard at the Ponca City, Okla., refinery as a pipe-fitter. He submitted his idea Dec. 6, 1944, entitling it a suggestion to "construct dump truck to handle breeze coke and water from Dubbs units." He describes his idea as follows:

"I suggest that a dump wagon be built to reclaim the breeze coke which results from a regular clean out of the Dubbs pressure still units. This water and coke is drained to a large filter box from which it has to be shoveled out and hauled away. This wagon will hold an entire cleanout water wash and coke, and when settled out can be hauled out for dumping, and the wagon returned for the next cleanout.

"Proposals have been made for the reclaiming of breeze coke that is trapped in the filter provided for cleaning up water used in the decoking process. These proposals have involved expensive equipment and required considerable labor to complete the reclaiming job.

"My idea is to build a dump wagon equipped with suitable filter screens and use this wagon for the filter proper as shown in the attached sketch. (Fig. 3).

"The cost involved is the building of the dump wagon and preparing the location. The labor for the operation would be the tractor and driver for 30 minutes each cleanout. It is estimated that two tons of coke per cleanout will be involved.

"Present operation consists of shoveling the trapped coke from the filter with no product reclaimed.

"If the installation requires $500 and the tractor and driver figured at $3 per hour, the job would pay out in 160 days and the gain from then on would amount to $3 per day."

A month later the operating division involved made the following recommendation:

"We believe that the idea is a simple and practical solution to a problem that we have been giving much thought to recently. The suggestion originated at Ponca City where it will be installed. We are studying the possibility of installing an adaptation of the suggestion at East Chicago, but earnings are based on Ponca City."

Estimated savings were calculated at $1095.75, on basis that a maximum of 365 tons of coke would be saved annually (at $3.75 per ton) for a total of $1368.75. Labor expense involved would amount to $1.50 per day for 182 days, or $273 annually. Cost of installation, not considered in computation of savings, was placed at $500. The division then recommended an initial award of $100 in war bonds and a supplemental award if the suggestion is used in other company refinery operations or actual earnings exceed estimate.

In this case, there are several units at the East Chicago refinery. Assuming comparable savings on each of them, this employe may eventually collect an additional $300 in supplemental awards and already has won the $200 prize for the best suggestion made in 1944.

BARTLESVILLE, OKLAHOMA

_____ 19 ___

Re: File No. _____

TO: Secretary
Suggestions Committee
Bartlesvillo, Oklahoma

Dear Sir:

The attached suggestion No. _____ received by this division is returned herewith checked by the proper parties.

Whenever possible, a monetary value will be given suggestions and the calculation briefly explained. If an actual savings cannot possibly be given, justification for the suggestion will be shown.

It will (will not) be adopted because _____

Estimated savings _____ How calculated _____

Cost of installation _____ We plan to install them at _____

In our opinion it can (cannot) be applied to other divisions. We recommend an award of $ _____.

Yours very truly,

_____
Manager

Checked By _____

Checked By _____

Checked By _____

**Report form used by operating division managers in detailing their recommendations regarding suggestions and suggested awards**

## Order Reprints Promptly

Inquiries for reprints in quantities of articles appearing in NPN's Technical Section should be forwarded promptly after receipt of the issue, by telegram if possible. Present conditions make it impossible to hold the type in the forms after the issue has been published and reprints ordered after the type has been broken down have to carry the additional cost of resetting the article.

# "Tomorrow is *another* day"

Because, for almost a century, Powell Engineering has been anticipating the flow control requirements of products and processes still in the laboratory stage, Powell was ready to meet—and has met—every new demand imposed by war. Today we can justifiably say "there's a Powell Valve for every *known* requirement of industry."

But "tomorrow is another day" and it will bring new problems in flow control. Powell, as always, will be ready to solve them.

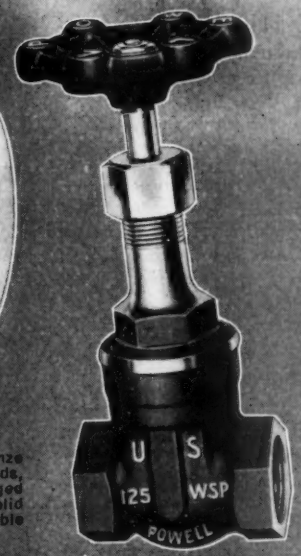
**The Wm. Powell Co.**

***Dependable Valves Since 1846***

**Cincinnati 22, Ohio**

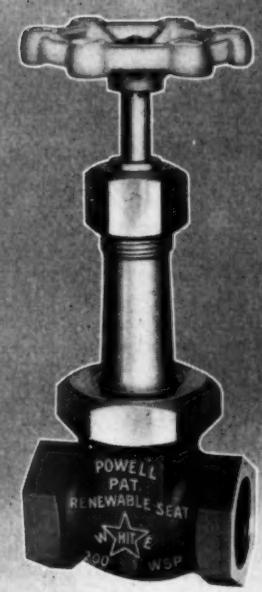
1793

Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve with Flanged ends, outside screw rising stem, bolted flanged yoke, bronze seats, and taper wedge solid disc. Available with taper wedge double disc—Fig. 1444.



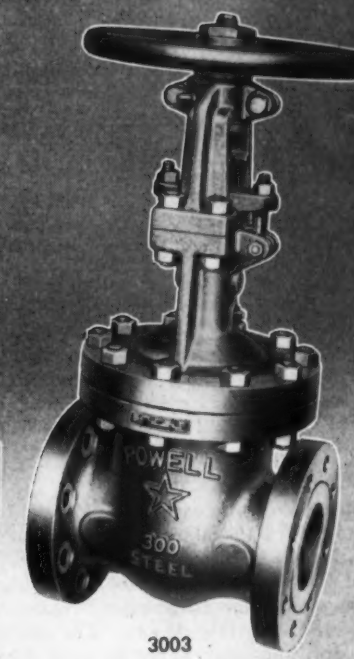

500

Fig. 500—125-pound Bronze Gate Valve, with screwed ends, inside screw rising stem, screwed bonnet and either taper wedge solid or double disc.




1375

Fig. 1375—200-pound Bronze Gate Valve, with screwed ends, inside screw rising stem, union bonnet and wear-resisting nickel bronze seat rings and disc.




3003

Fig. 3003—Class 300-pound Cast Steel Gate Valve, with flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc.

# POWELL VALVES

# SYNTHETIC LUBRICATING OILS

## Much and Varied Research Has Been Done by Oil Companies in This Country, Survey Shows, Despite Little Likelihood of Synthetic Lubricants Being Manufactured in Large Quantities for Some Time to Come.

*By B. H. Weil*

DURING the past two decades, the subject of synthetic lubricating oils has been receiving a great deal of attention both here and abroad. In the latter case, more than exploratory and academic interest has been involved, for the desire for economic self-sufficiency fostered in Germany by National Socialism and in England by a counter self-defense has caused these and other nations actively to explore into and to develop methods of producing commercial lubricants from sources other than crude petroleum, of which they have small national resources.

In this country, the situation has been vitally different. Domestic petroleum supplies have always proved adequate to meet the demands placed upon them even in wartime (albeit with considerable effort).

There is indeed some question as to whether this picture will prevail indefinitely, but such doubt is primarily concerned with the production of sufficient liquid fuels, not with lubricants; for it has recently been stated that "more than half of our 'lube' oil stock and about 65% of our wax stock are being converted to motor fuel by cracking."

The petroleum executive who is the authority for the above statement points out that there are, at present, perfectly good economic reasons for "degrading" these potentially high-priced materials into lower-priced products. The market for lubricants and waxes is small when compared with that for motor fuel, hence more "lube" oil stocks are obtained in refining than can be further refined and profitably sold. Moreover, conversion to motor fuel is cheaper than conversion to high-quality "lube" oils and waxes.

### Bibliography Available

The bibliography of 580 references mentioned in this article on "Synthetic Lubricating Oils" is available in reprint form. It contains 204 literature references and 376 patent references.

Copies of this bibliography (up to five) can be obtained without charge by writing to the Technical Editor, National Petroleum News, 1213 West Third St., Cleveland 13. Quotations for larger quantities will gladly be furnished on request.

For these reasons, only the best stocks requiring the least treatment are now being used. If and when demand requires it, however, more stocks will be utilized. Thus, while "lube" oil yields will then be lower, and costs will be higher, no shortage comparable to that which may eventuate for gasoline from domestic crudes may be expected in the predictable future.

Nevertheless, despite the fact that the need for development of synthetic lubricating oils is not particularly urgent, many domestic petroleum companies, and others, have more or less actively concerned themselves with the synthesis of lubricants. Such research has occasionally erupted into near-commercial developments, as for example when lubricants produced by polymerization of cracked wax were marketed for a time during the last decade, but high costs for such synthesis and continued improvements in the preparation of lubricants from petroleum have served to limit most activities to the research level.

The war, however, has served as an added stimulus to general interest. Allied forces have been fighting an enemy (Germany) which has had to make extensive use of synthetic lubricants and which has not suffered particular mechanical difficulties from this necessity.

Supplies of these lubricants have from time to time been captured, and while details of tests performed upon them cannot be disclosed, consensus seems to indicate that certain of these synthetic lubricants compare with the best ones separated from petroleum.

There are many ways of preparing synthetic lubricants. Much of the work which has been done abroad concerns the synthesis of lubricants from coal and its derivatives, since most countries possess an abundant supply of these materials. Considerable work has also been done on synthesis from the nonlubricant fractions of petroleum—olefinic gases, cracked distillates, cracked waxes, etc.

Much work certainly remains to be performed before quantity production of lubricants which can compete in versatility and price with those from petroleum can be accomplished, but it does seem certain that progress can be made.

Since most of what little is known about synthetic lubricants is contained in the literature, and since this literature has already shown signs of becoming both voluminous and diffuse, this survey has been prepared in an attempt to correlate facts and claims in a manner which may prove of value in the interpretation of future developments.

Actually, however, the literature on the subject of synthetic lubricants is far from being either detailed or in complete agreement. Much of the foreign data seems mere propaganda or an attempt to "make the best of a bad thing." Advertising considerations may also be detected in certain American publications.

Nevertheless, many general methods of synthesis have been clearly indicated in both patent and periodical references, and future research and a better understanding of the required molecular structures of good lubricants may be expected to clarify the situation.

### Scope of Survey

There are many fields related to lubricant synthesis which have been disregarded here in an attempt to obtain reasonable brevity. For example, many synthetic lubricant additives are closely related to actual synthetic lubricants, but the former exist in such great numbers as to necessitate their exclusion where identifiable. Similarly, many lubricant refining methods border upon actual synthesis, yet have had to be excluded.

Chief among the latter methods is the hydrogenation of heavy nonlubricant and semilubricant fractions of petroleum. This process may well become of considerable importance and is definitely related to processes discussed in this survey (such as the hydrogenation of coal tars), but the extent of the literature involved made its inclusion impractical.

In a few cases, of course, it was impossible to adhere strictly to these imposed limitations. For example, a few borderline references to aluminum chloride treatment seemed worthy of inclusion. Also, since classification of references was chiefly done from abstracts obtained from secondary sources, it is probable that a number of references were not classified under all their pertinent subjects.

Emphasis in this survey has been placed on the synthesis of lubricants from cracked (unsaturated) products, light and heavy, whether from petroleum waxes, Synthine products, hydrocarbon gases, or tars. It has seemed desirable to discuss such syntheses from the standpoint of the unit organic processes involved, followed

*B. H. Weil is Chief Information Specialist of the Chemistry Division, Gulf Research & Development Co., Pittsburgh. He was co-author of the series of articles, "ABC of Chemical Derivatives from Petroleum," which appeared in the NPN Technical Section and is senior author of the recent book, "Plastic Horizons."*

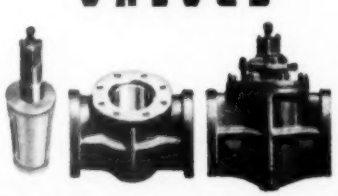
# *The laws of Physics never change*

A FALLING apple brought forth Newton's Law of Gravity. Newton did not create a principle; he simply interpreted it. The principles of traveling pulleys, of fulcrums, levers and plug cocks are ABC's of physics. In valves, the most basic closure is a tapered plug. The Egyptians used it 5000 years ago. But because a plug would stick, Industry had to resort to gate closures, using a wedging principle. Then, when valves had to contend with high line pressures, extreme temperatures and corroding fluids, *trouble began.* So, Nordstrom applied Pascal's Law. He revolutionized the use of a plug valve by introducing pressure lubricant to seal the ports and make the plug easy to turn. He took the oldest of principles, applied modern engineering and thus solved the need for an all-purpose plug valve to give satisfactory service forever.

***KEEP UPKEEP DOWN WITH NORDSTROMS***

**MECHANICAL PERFECTION REQUIRES PRESSURE LUBRICATION IN VALVES**

## NORDSTROM VALVES



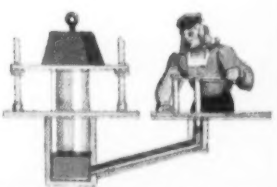
Basically, the Nordstrom consists of a plug and body. By turning a lubricant screw, multiplied pressure is transmitted through grooves in the plug and body to the bottom of the plug. Leakage is prevented regardless of line pressure.



**TRAVELING PULLEY**

**LEVERAGE**

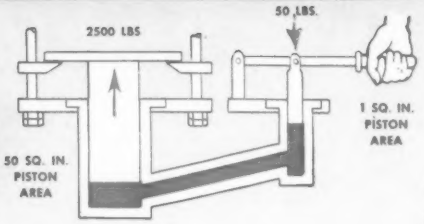
**PLUG COCK CLOSURE**



**HYDRAULIC PRESSURE**

*(Pascal's Law)*

# PASCAL'S LAW WAS NEVER SO NECESSARY AS TODAY!




Nordstrom Lubricated Valves make use of the scientific principle known as Pascal's Law, as illustrated above. This law states that "a unit pressure applied to the liquid contained in a sealed vessel is transmitted to every part of the liquid with undiminished force," thus multiplying the force many times. Note how this law is applied to the plug.

## *For positive flow-line control*

**Lubrication within a valve definitely increases efficiency of operation and adds ultimate life. Pressure lubrication makes possible the use of a plug valve for highest pressures, and in large as well as small sizes. The Nordstrom "Sealdport" system not only provides lubrication to make the plug easy to turn but establishes a positive, leak-resistant seal around the ports. Unless a valve is lubricated it cannot give the fullest life. Lubrication is both vital and essential. It is what has made Nordstrom Valves *indispensable* for countless services in the petroleum, gas and chemical industries.**

# Nordstrom LUBRICATED VALVES

*Sealdport Lubrication*

**MERCO NORDSTROM VALVE COMPANY** — *A Subsidiary of Pittsburgh Equitable Meter Company*

*Main Offices:* 400 Lexington Avenue, Pittsburgh 8, Penna. • *Branches:* Atlanta, Boston, Brooklyn, Buffalo, Chicago, Columbia, Houston, Kansas City, Los Angeles, New York City, Oakland, San Francisco, Seattle, Tulsa • *Canadian Licensees:* Peacock Bros., Ltd., Montreal
*European Licensees:* Audley Engineering Co., Ltd., Newport, Shropshire, England • *South American Representative:* The Armco Int'l Corp. • *Main Office:* Middletown, O.
**PRODUCTS:** Nordstrom Lubricated Valves; Air, Curb and Meter Cocks • Nordco Valve Lubricants • EMCO Gas Meters • EMCO-McGaughy Integrators EMCO Regulators • Pittsburgh-National Meters for Gasoline, Grease, Oil, Water and other Liquids • Stupakoff Bottom Hole Gauges

by discussion according to the basic raw materials. Considerable duplication is involved in this method, but the ends obtained seem to justify this.

### General

There are, of course, a number of literature and patent references which are too general or too specialized to be classified conveniently under the more important unit processes and raw materials. Many of these are important surveys of the field, while others deal with theory and the properties of the synthesized lubricants.

Among the more important surveys on the subject of synthetic lubricants the following references can be listed:

(1), (15), (32), (35), (39), (43), (44), (45), (51), (71), (78), (79), (80), (81), (87), (88), (95), (107), (108), (110), (111), (112), (113), (114), (115), (127), (133), (134), (135), (142), (148), (154), (157), (190), (201), (202), (204), and (375).

Many of these articles are outdated and give emphasis to methods of interest to a particular country only, but all are significant in that they at least analyze the situation in some detail.

Many references deal with the composition, properties, and chemical structure of lubricants and the relationship of these factors to their synthesis. These are, of course, prime considerations, but unfortunately too little is clearly understood concerning them. Chemists have not yet definitely related the lubricant properties of petroleum fractions with their molecular structure, since the latter has only recently become at all clear.

According to a recent source[76a], it would seem that petroleum lubricant fractions are chiefly composed of derivatives of dicyclic naphthenes, mixed with a small proportion of derivatives of monocyclic naphthenes and a few compounds of mixed aromatic-naphthenic nuclei. Few of these are compounds of simple structure, since it is probable that they are "extensively substituted by hydrocarbon groups, probably mostly of alkyl nature." In the more paraffinic lubricants, more than half of the carbon atoms may be located in these side chains; while in the more naphthenic lubricants only about one-third may be so located.

These recent theories cast into discard the belief that straight-chain, unsubstituted paraffinic structure is the prime criterion for good lubricants, also that olefinic structure is any consideration. They also serve to provide a background for future research, which is obviously needed if excellent synthetic lubricants are to be prepared. Data on these and conflicting theories may be found in the following references:

(10), (45), (48), (53), (69), (71), (85), (87), (88), (90), (91), (92), (102), (107), (108), (109), (112), (113), (114), (115), (129), (140), (148), (154), (169), (174), (175), (185), (189), (201), (202), and (375).

Many of these references also deal specifically with the properties of synthetic lubricants; among these are:

(69), (85), (102), (108), (109), (112), (114), (115), (140), (171), and (175).

The preparation of lubricating oils from plant products—natural oils and their derivatives—is dealt with in the following references:

(21), (22), (23), (30), (47), (49), (53), (54), (76), (111), (116), (118), (165), (196), (198), (211), (248), (286), (334), (336), (341), (358), (371), (372), (387), (410), (427), (429), (436), (497), (529), and (577).

The value of these substances is not clear, although much is claimed for them; it is probable that some are specialty-type products, although some resemble other synthetic lubricants in that their synthesis includes preliminary formation of an olefinic hydrocarbon structure, followed by polymerization, etc. The noncarcinogenicity of certain synthetic lubricants is the subject of (197).

Work of the British Fuel Research Board is discussed in:

(10), (11), (13), (17), (18), (83), (84), and (187).

This group has conducted some excellent research on the attempted synthesis of lubricants by polymerization of tar, hydrogenation of coal, condensation of aromatics with olefins, polymerization of olefins (including Synthine products), and the like.

The synthesis of lubricants by aluminum chloride treatment of nonlubricant hydrocarbons is dealt with in (51), (469), and (495). As mentioned, these are of border line interest as regards this survey. Miscellaneous references include:

(19), (30), (31), (37), (70), (75), (93), (100), (129), (136), (252), (260), (401), (463), (464), (467), (473), (477), (484), (494), (503), (508), (521), (569), (571), and (572).

### Polymerization

Polymerization is one of the most important of the unit organic processes used for the synthesis of lubricants. It bears close analogy to condensation and alkylation, however, and this should be kept in mind when considering these subjects, which will be discussed later; cross-referencing has been attempted.

The Synthine process uses polymerization reactions extensively for the synthesis of lubricants, and reference should be made to the section on this subject, since cross-referencing would have involved straight duplication.

Numerous references deal with the synthesis of lubricants from ethylene. Stanley[177] believes that the action of $AlCl_3$ on ethylene can be explained by: (1) polymerization to higher olefins, (2) isomerization of the latter to produce the corresponding cycloparaffins, and (3) the splitting off of lower paraffin molecules with the simultaneous production of hydrocarbons of lower hydrogen content.

Nash, Stanley, and Bowen[137] note that, under pressures up to 60 atm., polymerization to light and heavy oils occurs above 325°C. without a catalyst and that the use of $ZnCl_2$ lowers the required temperature to 230-275°C., while the use of $AlCl_3$ requires a temperature of only 180°C. Petrov[149] used $AlCl_3$ powder at room temperature and at 100°C. in his experiments.

Atkinson and Storch[26] have concluded that good "light" lubricants can be prepared from lower members of the olefin series by first polymerizing to a liquid boiling in the gasoline range, then further polymerizing with $AlCl_3$. Hartley, Sinnatt, et al[84] used a molybdic acid catalyst at 350°C., also treating their low-viscosity products with $AlCl_3$.

Hall and Nash[82] used aluminum, magnesium, or zinc, along with $AlCl_3$, to suppress cracking side reactions. Hessels, van Krevelan, and Waterman[86] report the synthesis of high V.I. lubricants from ethylene, using $AlCl_3$ below 100°C. in the presence of nickel or nickel alloys. Other references to the polymerization of ethylene include (247), (273), (283), and (539).

Lubricant synthesis by the polymerization of ethylene, propylene, or isobutylene is the subject of (143) and (217); $BF_3$ is used as the catalyst. This latter catalyst has been frequently mentioned in the synthesis of high V.I. lubricants from isobutylene, in the presence of dimers and trimers of the latter, at temperature between —50° and 150°C.:

(256), (304), (306), (315), (367), (511), (552), (554), (555), (565), and (567).

Sulfuric acid has also been used as a catalyst[351]. References (55), (132), (139), and (576) mention the synthesis of lubricant from $C_5$ olefins. Numerous other references deal with the preparation of lubricants from various gaseous olefins:

(38), (71), (132), (147), (209), (225), (244), (246), (247), (275), (278), (283), (300), (304), (310), (317), (353), (360), (373), (383), (385), (386), (391), (396), (398), (438), (453), (458), (471), (479), (489), (498), (524), (534), (537), (539), (540), (553), (559), (560), (563), (564), (568), and (570).

Considerable attention was attracted in the last decade to the commercial preparation of synthetic lubricants by the Standard Oil Co. of Indiana:

(4), (5), (6), (7), (8), (9), (28), (52), (65), (162), (163), (180), (181), (240), (309), (476), (520).

These lubricants were prepared by the cracking of wax, followed by $AlCl_3$ polymerization. Called "Syntholubes" and sold for 50 cents per quart in five-gallon drums, these lubricants were said to have good V.I.'s, excellent oxidation and sludge resistance, low pour points, and long service lives. The literature does not record the reason why Syntholubes were eventually withdrawn from the market, but economic considerations probably were the dominant factors.

Innumerable other references deal with the preparation of lubricants by polymerization-treatment of cracked light and

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heavy petroleum fractions, using $AlCl_3$ and other agents as catalysts. Among these are:

(33), (38), (50), (77), (78), (83), (121), (127), (146), (159), (187), (192), (203), (206), (219), (228), (238), (242), (243), (245), (249), (253), (255), (257), (262), (264), (265), (267), (275), (281), (298), (299), (302), (308), (312), (316), (319), (323), (331), (333), (337), (339), (340), (342), (343), (345), (348), (359), (365), (368), (391), (392), (393), (396), (398), (399), (407), (408), (412), (420), (422), (425), (432), (434), (450), (461), (482), (483), (487), (496), (501), (502), (504), (505), (506), (507), (509), (510), (513), (514), (519), (525), (531), (534), (538), (541), (544), (548), (550), (556), and (557).

The preparation of lubricants from olefinic Synthine products and cracked wax is directly related to this subject, and reference should be made to the discussion on that topic.

General reviews on the polymerization of hydrocarbons as a means of preparing lubricating oils include (117), (138), and (169). The use of $AlCl_3$ and other Friedel-Crafts catalysts is described in (130), (132), and (136); references (251), (344), (430), (474), and (488) may also be pertinent here. The preparation of a double compound of $AlCl_3$ and ethylene, suitable for use in condensing hydrocarbons, is described in (236) and (396).

The polymerization of unsaturated coal tar fractions is discussed in:

(176), (219), (228), (253), (264), (265), (267), (331), (342), (391), and (392).

Most of these references are patents, hence it is impossible to judge the quality of the lubricants produced.

Dechlorination of synthetic lubricating oils prepared by polymerization (or condensation) using chlorine-containing catalysts is discussed in:

(314), (318), (426), (470), (549), and (580).

Such methods as clay contacting at 200-300°C. for more than 10 minutes, hydrogenation, or treatment with alkali metals have been proposed as ways of decreasing or removing the chlorine content.

A considerable amount of literature, patent and otherwise, has appeared in recent years on polymerization by use of the silent electric discharge, sometimes called "voltolization" after the name of an early process of this type. Much of this work concerns the preparation of lubricants, which are said to be viscous and to have flat viscosity curves. Reviews on this subject can be found in:

(20), (41), (151), (184), (196), and (200).

Voltages ranging from 500 to 14,000 volts at frequencies from 470 to 10,000 cycles per second are mentioned in these and other references, although 4,500 volts and 500-1000 cycles per second seem to be commonly recommended. Subatmospheric pressures are used, often with hydrogen as the atmosphere present. Voltolization products are frequently hydrogenated to improve their stability.

The effect of the silent electric discharge on fatty acids, mineral oils, and tars is described in (53), (54), and (76). Reference (2) deals with the use of kerosine. The "Elektrion" process is described in (49); this is one of the processes which uses a hydrogen atmosphere. As pointed out in (150), polymerization by the silent electric discharge differs from $AlCl_3$ polymerization in that it "occurs with paraffins, naphthenes, and aromatic compounds as well as with olefins."

The patent literature on the use of the silent electric discharge for lubricant synthesis is somewhat more diffuse than are the periodical references. Pertinent references include:

(211), (220), (222), (223), (232), (254), (266), (287), (290), (357), (363), (387), (433), (440), (480), (481), (523), and (547).

Substances capable of treatment to yield lubricants include, besides those already mentioned, shale oil, products from the hydrogenation of coal and tar, cracked petroleum oils, nonparaffinic and paraffinic petroleum extracts, Synthine products[289], [363], gases such as ethylene[221], [239] and methane and acetylene[239], and esters of fatty acids, including natural oils[358], [371], [387], [429].

Miscellaneous references to lubricant synthesis by use of the silent electric discharge include:

(72), (79), (110), (134), (152), (168), (204), and (208).

Many other references touch upon the synthesis of lubricants by polymerization. These include:

(11), (29), (32), (44), (47), (51), (71), (79), (80), (81), (109), (110), (124), (134), (135), (148), (154), (161), (165), (175), (197), (227), (236), (248), (260), (262), (279), (296), (321), (330), (375), (376), (377), (396), (414), (415), (418), (431), (465), (494), (496), (497), (500), (516), (517), (542), (546), (573), and (574).

### Chlorination and Dechlorination

The chlorination of hydrocarbons such as paraffin wax, followed by simultaneous thermal dechlorination and polymerization, is a process for lubricant synthesis which is closely related to polymerization and condensation. Ring formation also occurs during the last step of the process, which may also be conducted in the presence of $AlCl_3$ at lower temperatures. Paraffin hydrocarbons which may be used may also come from low-temperature tar, brown coal tar, or from the Synthine process. Pertinent references include:

(12), (183), (460), (522), and (536).

A somewhat similar process deals with the synthesis of oils from chlorinated fatty acids[21], [118]. Miscellaneous references which relate to this general subject include:

(21), (51), (79), (80), (81), (110), (154), (235), (267), (321), (403), (412), (425), and (426).

Reference should also be made to the discussion on the Synthine process.

### Condensation and Alkylation

The preparation of lubricants by the reactions of condensation and alkylation is a subject of considerable importance, closely related to polymerization and to the appropriate subsection of the discussion on Synthine products (which see).

The Friedel-Crafts alkylation of aromatic hydrocarbons with olefins to produce "valuable lubricants" is discussed in (199). Alkylation of coal tar products (naphthalene, tetralin, tar distillates, etc.) with ethylene at 100-310°C. in the presence of a silent electric discharge[168] is said to yield "high-grade lubricants," but alkylation in the presence of catalysts[94] is said to yield lubricants which are unsatisfactory because of the presence of undecomposed oxygenated compounds.

Viscous oils of low solidification temperature (about —40°C.) have been prepared by the alkylation of naphthalene with such alcohols as n-butyl, isobutyl, and isoamyl, in the presence of $AlCl_3$[145]

"Commercially interesting viscosities and viscosity indexes can be approached" by the chlorination of cracked residues and the alkylation of benzene with the chlorinated material[185]. The use of chlorinated paraffin wax for condensation with aromatic hydrocarbons is discussed in (193).

The engine testing of such oils is the subject of (194); these oils were said to be superior to a "commercial brand reference oil" in engine wear and consumption; very similar as to acidity, increase in carbon residue, and increase in viscosity; and inferior to the reference oil as to cylinder deposits. Related patent references include:

(214), (215), (218), (231), (242), (243), (245), (249), (269), (313), (320), (327), (340), (384), (389), (390), (407), (428), (439), (443), (444), (455), (456), (457), (468), (472), (515), and (532).

These deal with the condensation of olefins with hydrocarbons of the benzene and/or naphthene series. Reference (454) relates to the condensation of the naphthenic hydrocarbons of petroleum, shale oil, or tar with chlorinated light paraffins, reference (492) appears somewhat similar, since Coastal oils are heated with chlorinated hydrocarbons, such as amylene chloride, in the presence of $AlCl_3$. Biphenyl may be condensed with a chlorinated hydrocarbon to yield a lubricant[499]; use of diphenylene ether is mentioned in (268).

Reference (533) concerns the condensation of ethylene chloride with benzen; lower-boiling constituents of the product are said to have a V.I. of 80 or above and, when hydrogenated, 100 or above. Other references which deal with the condensation of aromatic hydrocarbons with halogenated aliphatic hydrocarbons include:

(213), (276), (280), (284), (288), (295), (301), (335), (337), (395), (419), (424), (446), (470), (477), and (561).

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taining not less than three rings is the subject of (294), (328), and (394).

The alkylation of tars or mineral oils or their fractions with gaseous olefins is dealt with in (325), (400), and (417). Reference (388) deals with the alkylation of an $SO_2$-extract (from the refining of oils) with olefins such as ethylene.

The "building up of high-molecular-weight hydrocarbons" from cracked petroleum and tar fractions in the presence of condensing agents such as $AlCl_3$ may well involve alkylation of the naphthenes and/or aromatics present with the olefins therein contained, even though the main reactions may be polymerization and (to a slight extent) cyclization. References which may be pertinent include:

(10), (123), (148), (227), (229), (233), (234), (305), (330), (339), (374), (375), (376), (377), and (483).

Condensation reactions between chlorinated hydrocarbons may produce synthetic lubricants even if naphthenic or aromatic hydrocarbons are not initially present. Thus it is said that an unsaturated heavy distillate prepared by cracking a wax may be chlorinated (by substitution) and condensed in the presence of a metallic halide[512]. Since synthetic lubricants of high viscosity index are said to result, it might be assumed that a small amount of cyclization occurs. Reference (566) is similar, except that a chlorinated paraffin wax is used. The other related references include:

(16), (259), 346), (406), and (416).

The alkylation of paraffinic hydrocarbons with liquid and gaseous olefins to yield synthetic lubricants is dealt with in (241), (256), and (562). Miscellaneous references include:

(12), (32), (51), (79), (80), (81), (110), (124), (138), (154), (165), (175), (226), (258), (279), (287), (296), (307), (311), (321), (412), (431), (435), (452), (460), (493), (496), (518), and (536).

### Lubricants from Coal

As previously mentioned, this subject is of considerable interest abroad, where much research has been done. The quality of the lubricants produced so far seems to be in doubt, except perhaps in the case of those synthesized from Synthine products; such lubricants, of course, are also derivable from natural gas.

The general literature on this subject consists chiefly of reviews which deal with use of earlier-mentioned unit organic processes:

(15), (35), (43), (80), (81), (134), (154), and (167).

Reference (173) is of particular importance in this connection, since it helps to fit lubricant synthesis into the general picture of "The Science of Coal-to-Oil Conversion." Miscellaneous references:

(12), (34), (210), (263), (282), and (324).

### Carbonization of Coal

Lubricants from coal carbonization, or, usually, from the products of coal carbonization, can be produced in several ways. Since these methods comprise polymerization (including use of the silent electric discharge), chlorination and dechlorination, condensation and alkylation, and the hydrogenation of tars (discussed elsewhere), reference should also be made to the discussions on these subjects, although a reasonable amount of cross-referencing has been attempted.

A great many of these earlier references concern the synthesis of lubricants from coal-tar chemicals such as benzene, naphthalene, and anthracene; no attempt has been made to include all of these here.

While the lubricating value of the oils produced seems to be doubted elsewhere[133], the following references report the synthesis of lubricants directly by the carbonization (usually low-temperature) of coal, followed by separation, in various ways, of the products:

(40), (42), (57), (58), (79), (120), (128), (170), (355), (361), (378), (379), (380), (381), (382), (441), (442), (459), and (545).

Recognizing the poor lubricating quality of most tar fractions, many attempts have been made to fit them for use as lubricants; such measures include esterification with alcohols and other types of chemical modifications:

(46), (97), (124), (126), (141), (205), (207), (347), and (382).

Reference (148) deals with $AlCl_3$ condensation and polymerization of tars. A general review of the preparation of lubricants from tars is given in (72). Miscellaneous references include:

(10), (16), (53), (70), (78), (79), (94), (133), (144), (168), (173), (176), (196), (219), (222), (223), (228), (241), (253), (264), (265), (267), (269), (276), (290), (291), (305), (325), (326), (331), (339), (342), (392), (417), (452), (453), (454), and (536).

### Hydrogenation of Coal

The periodical literature on the hydrogenation of coal is extremely voluminous, yet that part which deals with lubricants is far from illuminating. Several good reviews on coal hydrogenation itself exist[68], [155], [156], [179], but these deal only briefly with the synthesis of lubricants.

Somewhat more detailed data may be found in a recently-published book[120a]. This states that "the lubricating oils obtained from lignite by hydrogenation may be of various grades. Their quality may be controlled by the choice of catalyst and the temperature and pressure of the final liquid phase hydrogenation. The viscosity index of these oils is about 85, which is satisfactory for use in automobiles. The purity and melting point of the paraffin wax obtained by lignite hydrogenation are the same as those of paraffin wax from natural petroleum."

Lubricating oil yields of 13% are given for two different lignites on an ash- and moisture-free basis. A "fair" lubricant may also be obtained from some of the heavier fractions from the hydrogenation of bituminous and brown coals by "removal of asphalt, tar acids and bases, and of solid paraffins" by conventional processes, followed by rehydrogenation of the asphalt-free heavy oil over special catalysts in the liquid phase (before dewaxing).

The patent literature is somewhat more instructive than the periodicals and books, among such references being:

(224), (261), (322), (332), (349), (402), (405), (409), (447), and (448).

Other references of a miscellaneous nature include:

(11), (24), (32), (79), (83), (110), (133), (174), (190), (210), (216), (271), (285), (326), (328), (366), (369), (421), (449), (462), (466), (491), (527), and (528).

### Hydrogenation of Tars

The general subject of the hydrogenation of tars is closely related to the hydrogenation of coals and petroleum oils. The synthesis of lubricants by the latter method is not discussed in this survey, as mentioned. As regards the preparation of lubricants, it would seem that more has been published on this subject (especially as regards low-temperature tars) than on the hydrogenation of coal.

References concerning experiments on the hydrogenation of tar residues include:

(96), (160), (161), (172), (201), and (202).

None of these references definitely claims that really good lubricants can be so produced. A comparison between voltolization and hydrogenation of tars is made in (152); a combination process is suggested.

The patent literature also contains a number of pertinent references including:

(212), (285), (297), (329), (362), (413), (447), (449), (451), (462), (485), (490), and (526).

Some patent references deal with the hydrogenation of a bituminous extract obtained by solvent extraction of coal; this subject is closely related both to the hydrogenation of coal and of tars:

(366), (369), (397), (404), (491), (528), and (551).

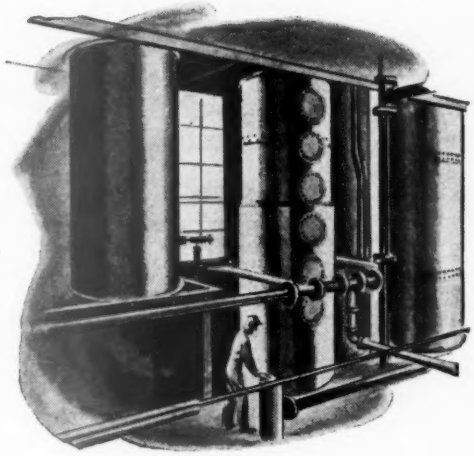
References of a miscellaneous character include:

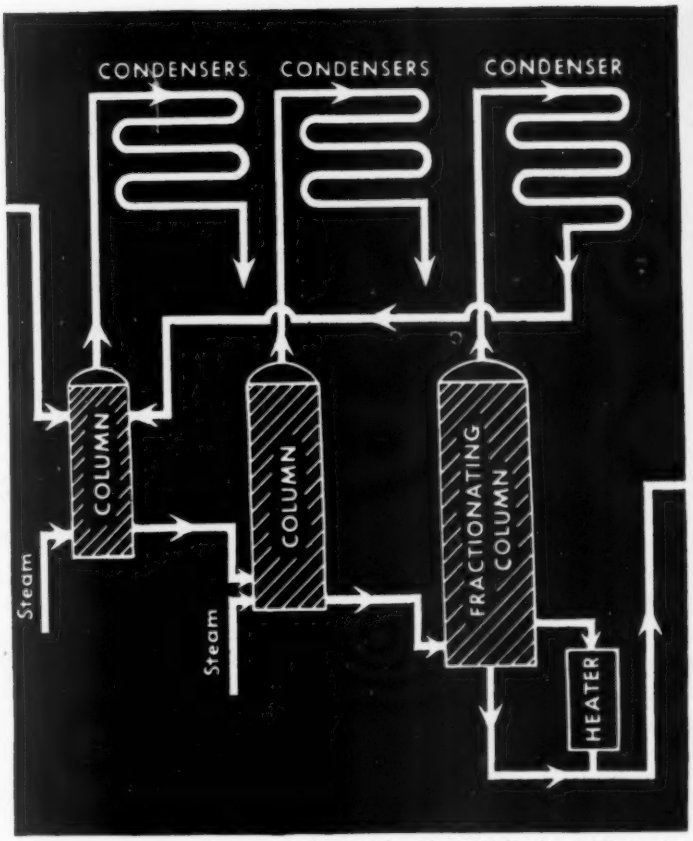
(24), (32), (68), (72), (79), (135), (154), (156), (174), (187), and (216).

### Synthine Process

As mentioned, the Synthine (Fischer-Tropsch) process is currently of as much interest to natural gas interests as it is to the coal industry, since the intermediate "synthesis gas" ($CO + 2H_2$) can be produced from either raw material. The process is of special interest in regard to synthetic lubricants manufacture in that it is known to have been in considerable use in Germany during World War II, although no lubricants as such are directly produced (references (270) and (352) to the contrary).

As stated in (119), the three general



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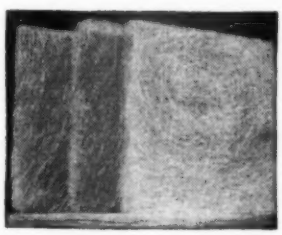

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methods now used for the synthesis of lubricating oils from Synthine products are: (1) condensation of olefin-rich, lower-boiling fractions in the presence of $AlCl_3$; (2) formation of olefins from paraffins (e.g., by cracking or by halogenation and subsequent dehalogenation), followed by condensation with $AlCl_3$; and (3) condensation of chlorinated fractions with aromatic hydrocarbons in a Friedel-Crafts type reaction.

As can be seen, all of these processes have previously been discussed in relation to hydrocarbons from other sources. The corresponding sections should be consulted for related aspects of the subject, since cross-referencing would involve considerable duplication.

A number of excellent surveys on this subject exist: (107), (120a), and (154). Other good surveys include:

(14), (25), (60), (61), (62), (63), (71), (103), (106), (119), (125), and (166).

The preparation of lubricants by the first method mentioned above is dealt with in:

(59), (60), (64), (73), (87), (88), (106), (108), (112), (114), (125), (182), (188), (230), (272), (277), (291), (365), (370), (430), (445), and (579).

Tables 1 and 2 detail some of the points of interest of lubricants prepared in this manner.

The first alternate of the second method; i.e., the one which includes preparation of the necessary olefins by cracking, is discussed in:

(113), (188), (274), (303), (354), (537), (543), and (558).

Intermediate chlorination and dechlorination as the source of the desired olefins is mentioned in (104).

The condensation (alkylation) of chlorinated fractions with aromatic hydrocarbons, the third method mentioned above, is the subject of:

(59), (60), (105), (188), and (423).

Table 3 shows a comparison between two lubricants prepared by this method. Condensation of the chlorinated fractions without aromatics is mentioned in (60) and (105).

In some cases, it has been found desirable to hydrogenate catalytically the Synthine-based lubricants:

(59), (107), (112), (113), (293), and (537).

Higher viscosities are said to result, although little effect upon viscosity index is reported.

The properties, performance, and testing of these synthetic lubricants are discussed in:

(59), (60), (87), (88), (99), (107), (108), (112), (113), and (115).

Synthine-based lubricating oils are asphalt-free, have good aging properties, and, upon use, show less-than-average increase in acid and saponification numbers and Conradson carbon. Structural studies on lubricants produced by the first two methods show about one to three

**TABLE 1—Comparison of a Commercial Petroleum Lubricant and a Synthetic (Synthine) Oil***

| | Commercial Winter-Oil | Synthetic Oil |
|---|---|---|
| Specific gravity at 20°C. | 0.882 | 0.838 |
| Viscosity (Engler): | | |
| at 20°C. | 32.6 | 32.0 |
| at 50°C. | 6.10 | 6.06 |
| Viscosity index | 60-70 | 60-70 |
| Pour point | —16°C. | —42°C. |
| Flash point, open crucible | 220°C. | 205°C. |

* From Bibliographic Reference No. 59.

**TABLE 2—Polymerized Oils from Olefinic Synthine Fractions***

| Fraction | Volume Per Cent of Crude Synthinate | Olefin Content, Volume Per Cent | Polymerized Oils: Specific Gravity ($d_4^{20}$) | Viscosity Degrees Engler at: 20°C. | 50°C. | Pole Height | V.I. |
|---|---|---|---|---|---|---|---|
| 50-100°C. | 22.5 | 39 | 0.835 | 29.9 | 4.75 | 3.59 | 5 |
| 100-150°C. | 20.0 | 27 | 0.836 | 28.1 | 4.80 | 3.01 | 20 |
| 150-200°C. | 19.5 | 18 | 0.835 | 18.7 | 4.00 | 2.28 | 80 |
| 200-250°C. | 13.0 | 11 | 0.827 | 6.12 | 2.17 | 1.69 | 100 |

* From Bibliographic Reference No. 59.

**TABLE 3—Comparison of Two Synthetic Lubricants Produced by Condensing Chlorinated Synthine Gas Oils with Xylene***

| Properties | Oil No. 1, from Tetrachlorinated Synthine Gas Oil** | Oil No. 2, from Trichlorinated Synthine Gas Oil*** |
|---|---|---|
| Specific gravity at 20°C. | 0.9738 | 0.9351 |
| Viscosity (Engler) at: | | |
| 20°C. | ..... | 101 |
| 50°C. | 49.1 | 10.84 |
| 75°C. | 8.7 | ..... |
| 100°C. | 2.9 | 1.87 |
| Viscosity index | Below 0 | 90 |
| Pour point | —1°C. | —20°C. |
| Conradson carbon, per cent | 0.26 | 0.17 |
| Sligh oxidation No. | 11.6 | 1.0 |

* From Bibliographic Reference No. 59.
** Reacted three times with xylene.
*** Reacted twice with xylene.

naphthene rings per molecule. Differences in certain of the finished oils are said to depend upon the variation in the olefin concentration and the constitution of the olefin isomers initially present. Reference may again be made to Tables 1-3.

It should be noted that all of the reported work concerns the use of products from the usual Synthine process, that is, the use of essentially straight-chain olefins. Newer variations of the Synthine process are said to yield naphthenic and isoparaffinic hydrocarbons.

While these are of far better octane number as regards their presence in the gasoline fraction, it is conceivable that they would not be particularly suitable for the synthesis of high-grade lubricants. Nothing has yet been published on this subject, but it is certainly a factor to keep in mind in evaluating the versatility of a particular variation of the Synthine process.

Miscellaneous references to this process include:

(11), (13), (16), (24), (32), (33), (36), (66), (89), (110), (131), (133), (153), (164), (195), (289), and (363).

### Shale Oil

The standard texts on the subject of shale oil and its derivatives were not directly consulted for this survey, but reference to them may be made, if desired, through use of the bibliography of a recent article[191] on this general subject, especially these references:

(1), (4), (5), (6), (8), (12), (14), and (15).

It would seem that, in general, lubricating oils of varying properties and yields can be obtained from many shale oils by distillation, followed by conventional treatment. Refining losses are often higher, however, and so are costs. Heavy lubricants are probably not conveniently obtainable.

Of the literature included in this survey, (122) deals with the preparation of lubricants by steam-distilling asphalt oils obtained from "bituminous limestone." According to (98), the carbonization of a low-ash Scottish cannel yields a tar which does not contain lubricant fractions but is a "promising raw material for the synthesis of lubricating oils." The Japanese have attempted to prepare lubricating oils from the $SO_2$-soluble fraction of a shale oil kerosine[161].

Pier[158] reports high yields of lubricating oils, corresponding to Pennsylvania machine oils, from the catalytic hydrogenation of shale oils. Miscellaneous references include:

(30), (31), (39), (70), (224), (265), (290), (454), (463), and (466).

### Petroleum

Obviously, any detailed discussion on the synthesis of lubricating oils from non-lubricant petroleum fractions would duplicate much which has already been

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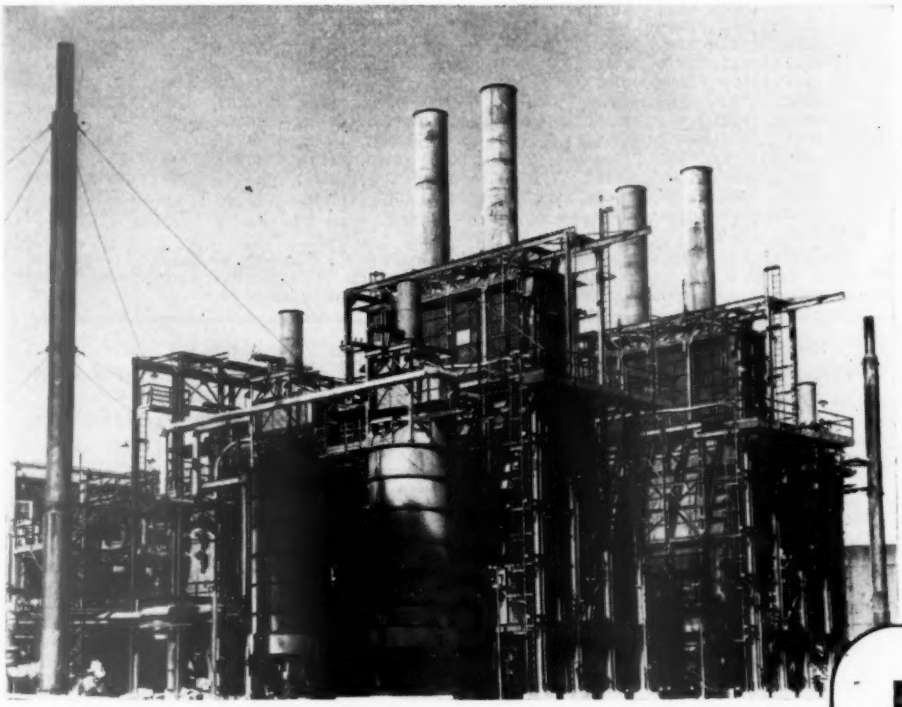

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TABLE 4—Article and Patent Bibliography References on Synthetic Lubricating Oils from Petroleum*

| From Olefinic Gases | From Cracked Distillates† | From Paraffin Waxes† | Miscellaneous |
|---|---|---|---|
| (13), (17), (26), (38), (44), (45), (51), (55), | (33), (44), (50), (51), (77), | (4), (5), (6), (7), (8), | (1), (2), (9), (37), (41), |
| (71), (79), (82), (84), (86), (94), (109), (110), | (79), (121), (136), (148), | (16), (21), (28), (52), | (45), (49), (53), (67), |
| (132), (133), (135), (136), (137), (139), (143) | (150), (151), (159), (184), | (65), (78), (121), (127), | (70), (76), (78), (83), |
| (146), (147), (149), (168), (177), (197), (199), | (185), (203), (206), (241), | (162), (163), (180), (181), | (91), (100), (111), (117), |
| (209), (214), (215), (217), (218), (219), (220), | (242), (245), (253), (255), | (183), (192), (193), (194), | (129), (130), (150), (151), |
| (221), (225), (231), (236), (239), (241), (244), | (257), (264), (265), (266), | (237), (238), (240), (241), | (156), (184), (196), (200), |
| (246), (247), (256), (273), (275), (278), (283), | (267), (275), (294), (296), | (243), (249), (254), (259), | (204), (211), (222), (223), |
| (300), (304), (306), (310), (313), (315), (316), | (298), (299), (302), (306), | (260), (262), (265), (268), | (228), (235), (251), (287), |
| (317), (320), (325), (327), (339), (351), (353), | (316), (318), (319), (323), | (269), (273), (276), (280), | (305), (308), (311), (329), |
| (359), (360), (367), (373), (374), (383), (385), | (326), (333), (339), (340), | (281), (284), (288), (292), | (331), (335), (344), (357), |
| (386), (388), (389), (390), (391), (394), (395), | (342), (343), (345), (348), | (295), (299), (301), (309), | (363), (406), (412), (416), |
| (396), (398), (400), (407), (428), (438), (439), | (365), (366), (368), (391), | (312), (337), (346), (395), | (417), (420), (424), (425), |
| (443), (444), (453), (456), (457), (458), (468), | (392), (393), (396), (398), | (398), (407), (419), (446), | (426), (430), (440), (454), |
| (471), (479), (484), (487), (489), (498), (500), | (408), (422), (434), (450), | (470), (472), (476), (483), | (460), (469), (473), (474), |
| (511), (515), (518), (524), (534), (537), (539), | (461), (477), (482), (488), | (486), (488), (499), (500), | (475), (481), (490), (492), |
| (540), (544), (552), (553), (554), (555), (559), | (496), (501), (502), (504), | (507), (512), (513), (514), | (495), (505), (516), (536), |
| (560), (562), (563), (564), (565), (567), (568), | (506), (508), (509), (510), | (520), (522), (523), (525), | (542), (546), (569), (573), |
| (570), (576), (578), (579). | (512), (519), (538), (541), | (531), (547), (561), (566). | (574). |
| | (548), (550), (556), (557), | | |
| | (564), (580). | | |

*Including by reaction with other materials. For synthesis from natural gas, reference should be made to the discussion on the Synthine process.
†The discussion on the Synthine process should be consulted for related references. Synthetic lubricants from paraffin waxes, listed in the third column, include those from chlorination, etc., as well as from cracking followed by polymerization or condensation.

said under the respective unit organic processes. Reference to the discussion on these processes should be made for any detailed study, but Table 4 has been compiled for the sake of convenient cross-referencing.

As can be seen from this table and the preceding discussion, a considerable amount of work has been done on the use of nonlubricant petroleum fractions. It is certainly possible that lubricants made from these fractions may some day appear again upon the market, when and if the price of petroleum lubricants increases; as has been mentioned, Standard of Indiana made an abortive attempt in this field a decade ago, marketing a lubricant produced by the polymerization of cracked wax.

### Conclusions

It is interesting to note that, among the patents included in this survey, the U. S. leads with 151, compared with 103 in Great Britain, 54 in France, 50 in Germany, and a total of six divided between Holland, Japan, and Russia. Taking into account the difference in the patent systems of these countries and the fact that many of the patents were applied for from abroad, it would still appear that there has been much interest in this country in the synthesis of lubricating oils.

In view of the generally higher costs of synthesis, however, as well as the complexities of the field, the domestic abundance of petroleum "lube" oil stocks, and the prospect that this abundance will continue, it seems unlikely that synthetic lubricants will be prepared in any quantities for some years to come. Continued research, meanwhile, may be expected to develop better lubricants, and the petroleum industry will certainly continue to view both foreign and domestic efforts with considerable interest.

## NEW BOOKS FOR THE REFINER

### A.C.S. Monograph Describes Chemistry of Acetylene

*The Chemistry of Acetylene*, latest of the American Chemical Society's series of monographs on chemical subjects, presents a brief but fairly complete account of the preparation, properties and reactions of acetylene.

Among the subjects covered are "The Physical Properties, Preparation and Purification of Acetylene", "Metallo-Derivatives of Acetylene", "The Substitution of Non-Metal Atoms or Radicals for the Hydrogen of Acetylene", "The Addition of Non-Metallic Elements and Compounds to Acetylene", and "The Polymerization of Acetylene and Condensation with Carbon Compounds."

Also included is an extensive classified bibliography of over 1700 literature and patent references. It is pointed out, however, that because of unavoidable delays in the completion and publication of the book, it has not been possible to cover the literature on most topics later than 1938.

Authors of this monograph are Julius A. Nieuwland, C.S.C., late professor of organic chemistry at the University of Notre Dame, and Richard R. Vogt, professor of chemistry at the same institution.

Copies of *The Chemistry of Acetylene* (219 pgs., 6 x 9 in., stiff cloth binding) can be obtained from the Book Department, National Petroleum News, 1213 West Third Street, Cleveland 13, for $4.00.

### New Reference Text On Formaldehyde

Formaldehyde is becoming an increasingly important commercial chemical, as indicated by its jump in production of 134,478,827 lbs of 37% solution in 1939 to an estimated 500,000,000 lbs in 1943. It is useful not only in synthetic resins, as a disinfectant and preservative, but also in chemical synthesis, paper manufacturing, leather and fur preparations, photography, and other miscellaneous items. One of the commercial methods of manufacture, at present contributing a limited but increasing quantity, is by the catalytic oxidation of natural gas and butane.

*Formaldehyde*, by J. Frederick Walker, represents the latest addition to the literature on this versatile product. Much has been written about this unique chemical, but unfortunately there has been no reference book published in English until now. *Formaldehyde* has been written to help fulfill the need for a systematic and critical account of the production and chemistry of the compound.

The chemistry of formaldehyde is complicated because it seldom is encountered in pure monomeric form, however well known it may be in the form of aqueous solution and solid polymers. This work first discusses normal and historical production methods, next dealing with the physical and thermodynamic properties of the chemical in its various forms, then detection and analysis and, last, its commercial uses insofar as war secrecy restrictions will permit.

The author is connected with the Chemical Research Division, Electrochemical Department of E. I. du Pont de Nemours & Co., Inc. at Niagara Falls, N. Y., manufacturers of this chemical.

*Formaldehyde*, 393 pages, 6 by 9 in., stiff cloth binding, may be obtained postpaid from the Book Department, National Petroleum News, 1213 West Third St., Cleveland 13, for $5.50.

**$AFETY PAY$ DIVIDEND$**

# Stop Accidents in Small Plants, Too

## Organized Safety Programs Are Practical Even for the Plant With Only 50 Employes; Results Include Greater Efficiency, Higher Morale, Lower Insurance Rates

*By William C. Uhl*

AN ORGANIZED safety program, even in the small plant, can be very effective.

We have reason to make that statement because as the result of such a program, accidents and lost time in our plant of 200 employes during the first quarter of 1945 have been less than half of the totals during the first quarter of 1944.

We had two injuries representing 34 days lost in the first three months of this year and five cases representing 98 days lost during the same period of 1944.

The 200 employes in our plant include office workers and research staff as well as operating personnel. However, an organized safety program is effective whether the employes total 50 or 50,000. It is effective the day accidents are reduced. It is effective the day one less employe is injured.

Accidents are costly. They cost management lost man hours, damaged materials and equipment. If they occur too frequently they cost a company its reputation and public goodwill. There is probably a plant in every community that is known to the general public as a "butcher shop" simply because so many persons are injured there. Accidents are costly to the workman, too. They result in lost or decreased earnings as well as physical pain.

A program whose aim is the elimination of accidents is "good business." It is a policy that pays dividends in the form of increased production efficiency and improved employe morale.

If your plant is covered by a state industrial compensation fund, an improvement in your accident record will produce a corresponding improvement in the insurance rates. If your plant is not covered by some form of accident insurance, and you pay expenses out of a general welfare fund, then a reduction in accidents will ultimately release funds for use in other programs such as capital improvement.

Cost studies made over the many years since organized safety became a part of business management have brought to light the fact that the direct medical and hospital expenses incurred in an industrial accident represent only 20% of the total cost.

Indirect or hidden costs have been found to average about four times the direct costs. Lost time of the injured employe, lost time of other interested or involved workmen and supervisors, lost production time, damaged materials and processing equipment are all a part of the hidden losses caused by an accident.

### Accidents Follow Pattern

Our plant happens to be a manufacturer of lubricant additives. But what we have done, are doing and will continue to do is applicable to any plant—"lube" oil, refinery or chemical—large or small.

Although chemical hazards may vary slightly with the processes in each type of industrial establishment, the other hazards follow a definite pattern.

Men still drop heavy objects on their toes, still fall from improperly placed or unsafe ladders and scaffolds, still forget to wear goggles, still try to lift too much, still cut and bruise their hands, still bump their heads or pick up splinters in their fingers—no matter whether they work in a refinery, a furniture factory, a "lube" oil plant, a machine shop or a chemical plant.

These human failures to observe safe practices have been found to represent 88% of the causes of all accidents.

Unguarded equipment, dangerous processing conditions and all hazards that can be corrected mechanically represent the other 12% of the causes.

These statistics have been determined over the many years of study since 1869, when Massachusetts established the first state bureau of labor statistics to determine the kinds and causes of industrial accidents.

Organized safety programs have been a consistent policy with most large companies for years. Unfortunately, many smaller industries have looked upon safety as too big a job as one of those "frills" that only a large concern can handle. Actually, this is not true at all. Accident prevention can easily become an integral part of the daily routine in any industry.

There are three fundamental requirements for any effective safety program:

1) Both management and employes must want to stop accidents.

2) A safe working environment must be provided.

3) There must be a safe performance by employes in that environment.

Once these three requirements are met, there are 10 important steps to follow in establishing a sound plan for accident prevention. Here they are, and here is what was done in our plant.

**1. Management Leadership:** The manager must do his part, make safety a necessary part of production, get back of it and keep back of it until every employe understands that the company proposes to make the plant a safe place in which to work.

Management convinces the men by visible signs. Our management has shown the employes the leadership required for any effective safety program by providing mechanical safeguards and protective clothing and equipment. In addition cooperation of supervisory personnel has been obtained and maintained.

**2. Appoint a Safety Director:** One man should be designated to represent management in directing the program. Whether he be called a director, engineer or supervisor is unimportant.

Our management established the safe-

### Accident Rates Defined

1. When accident records are compared on the basis of the number of injuries, the frequency rate is used.

The frequency rate is a measure of how often accidents are occurring and is defined as the number of injuries per million man-hours of exposure. The formula is:

$$F.R. = \frac{N \times 1{,}000{,}000}{E}$$

where $F.R.$ is the frequency rate, $N$ is the number of accidents, and $E$ is the total man-hours worked during the period for which the rate is to be calculated.

(2) When accident records are to be compared on the basis of days lost, the severity rate is used.

The severity rate is a measure of the seriousness of the injuries, and is defined as the days lost per thousand man-hours worked. The formula is:

$$S.R. = \frac{D \times 1{,}000}{E}$$

where $S.R.$ is the severity rate, $D$ is the number of days lost, and $E$ is again the total man-hours worked.

*William C. Uhl, author of the accompanying article on how to organize and set up a workable safety program in the small plant, is Safety Engineer with the Lubri-Zol Corp., Cleveland.*

ty department, saw to it that a member of the supervisory staff—a chemical engineer—studied industrial safety, and gave him the responsibility of the safety department activities, with the title of "safety engineer."

The safety engineer acts in an advisory capacity and answers to management through the plant superintendent.

3. **Analyze Accident Records:** As one of his first jobs after his appointment, the safety director should study the records of the accidents that have occurred in the past to learn the how, who, where, when, and why of each.

At the same time he must set up a systematic method for reporting current accidents so that he may watch the trends.

This phase of safety work is of extreme importance. It is only in this way that the basic causes can be discovered and steps taken to correct these causes.

Suppose that the safety director discovers that a series of accidents involving ladders is occurring in his plant. Further investigation probably shows two things wrong—the equipment and the procedure. A violation of two of the fundamental requirements exists, an unsafe environment and an unsafe performance.

Correction of the environment is then provided by equipping all ladders with non-slipping "safety shoes." Correction of the performance is taken care of by training employes in the proper use of ladders.

4. **Inspect Operations:** In the beginning, such inspections should be made by the safety engineer. The immediate purpose is to determine the physical condition of the plant and to check all hazards that need to be safeguarded.

The following list is typical of the items to be looked for in making inspections:

1) Fire hazards (flammable material storage, processing equipment, oily rags, etc.).

2) Fire protection (extinguishers, alarm systems, fire escapes).

3) Yard hazards (railroad crossings, open pits, exposed valves, lines, etc.).

4) Electrical hazards (defective lights, corroded wiring, open switches).

5) Hazards at machine point of operation (power saws, drill presses).

6) Power transmission hazards (unguarded belts, pulleys, gears).

7) Material handling hazards (defective conveyors, trucks).

8) Chemical hazards (acids, caustics, fumes).

9) Lighting (is illumination efficient?).

10) Ventilation (exhaust ducts and blowers).

11) Housekeeping (oil spills, uncleaned pump rooms).

We found it wise, after the initial inspection, to set up regular inspection schedules. For example all fire-fighting equipment is inspected monthly and general plant housekeeping is checked over every week. Certain types of fire hazards are also checked weekly, such as blocked or obstructed passageways, working areas and control panel boards. Some material handling devices such as overhead cranes demand a daily inspection, whereas a two-wheel hand-truck need be checked only once every three months.

The safety director should decide which operations are most hazardous, thereby necessitating the most frequent inspections.

5. **Start Mechanical Safeguarding:** Here is another opportunity for management to show its leadership.

Once the safety inspector has made his inspections, he must help management decide what should be done to eliminate the hazards he has discovered.

Joint conferences with the proper department heads will probably be necessary to determine in what order these problems should be handled.

Highly dangerous items will demand immediate attention. Others should be corrected as soon as possible in the order of decreasing potential hazards.

It will be well for the plant manager to decide in each individual case. However, he will need the advice of his operating heads and his safety director.

The important point to remember is to start the mechanical safeguarding *immediately*. This action will not only eliminate the majority of accident hazards that are within the control of management but it will also impress on the individual employe's mind that the company is sincere and willing to do its share in promoting safety.

6. **Provide First Aid Facilities:** The requirements for first aid facilities vary with the size of the plant. Properly administered first aid is a necessity for preventing minor cuts and bruises from developing into serious infections and lost-time cases.

We discovered after we had installed a small well-equipped dispensary in our safety office that the number of minor injuries apparently increased. Actually, the employes were learning that it was wise to come in and receive prompt attention in clean surroundings. They were no longer neglecting simple cuts and scratches. As a result, there was a reduction in the number of cases requiring the services of a physician because of subsequent infection.

Our equipment includes a treatment chair, sterilizing cabinet, illuminated magnifying glass on a stand, storage cabinet, waste disposal can and the usual first aid medicines and supplies.

While the average incidence of minor injuries in our plant does not require the services of a full-time industrial nurse, conditions in your plant might warrant such a step.

Our plant safety engineer and assistant factory superintendent, both trained first aid men, provide the necessary daytime help for taking care of minor injuries. Our plant operates around the clock seven days a week. All shift supervisors and foremen have been trained in caring for injuries.

If your operations are scattered over a large area, a centrally located dispensary may be out of the question. In this case it may be sufficient to provide first aid cabinets at strategic locations.

However, at least one of the em-

EMPLOYEE INJURY RECORD

Name _____ Dept._____
Injury Date, Time_____ Reported Date, Time_____
Injury:

Cause:

First Aid:

Case History (Over)

Sent Home _____ Sent to Dr._____ Sent to Hosp._____ Back to Lite Wk____ Back to Reg. Wk.___
Claim Issued_____ Claim Ret'd._____ Claim Fwd'd._____ Claim No._____

Med. & Hosp. Fees Paid:
Compensation Paid:

S-12-44 Case handled by _____

**Records are an important part of any organized safety program. All accident cases reported, whether minor or major, should be recorded on a form such as the one shown above. A periodic analysis of these records will show up dangerous trends which can often be corrected before they become serious**

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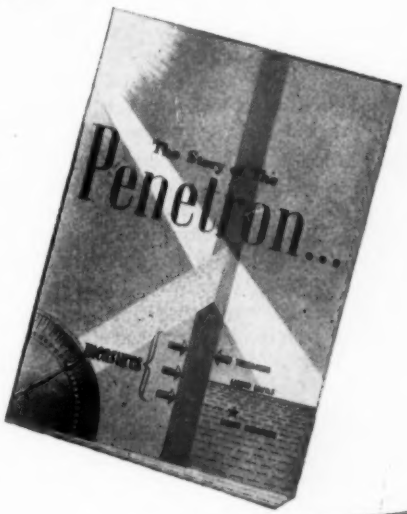
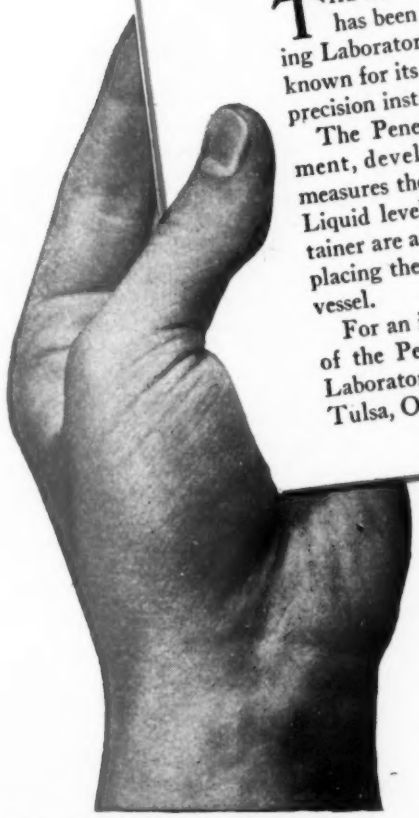
THE manufacture and sale of the Penetron has been placed in the hands of Engineering Laboratories, Inc. — an organization well known for its experience and skill in the field of precision instruments.

The Penetron is the new, portable instrument, developed by Texaco research, which measures the thickness of any type of material. Liquid levels and liquid density within a container are accurately and quickly determined by placing the Penetron against the outside of the vessel.

For an illustrated booklet that tells the story of the Penetron, please write to Engineering Laboratories, Inc., 610-624 East Fourth Street, Tulsa, Oklahoma.



TEXACO

**TEXACO DEVELOPMENT CORPORATION**

*A Subsidiary of The Texas Company*

REPORT OF SAFETY HAZARD No._____

Dept._____Location_____

Reported; Date_____ by_____

Equipment:

Hazard:

Correction Needed:

Reported to:_____ date_____

Work Completed_____

**Suggestions from department heads and workers frequently uncover hazardous conditions and offer solutions to eliminate them. All such recommendations, together with reports made by the safety department itself, are recorded on 4 by 6 in. cards and filed. In this way a continuous record is maintained of the status of all safety hazards**

ployes working in each area should be trained in first aid. Furthermore, he should be provided with the means for reporting accidents and injuries so that the records can be kept up to date.

7. **Make General Announcement:** Most of the important preliminaries have been covered. The workers should now be acquainted with the accident prevention program.

This information must come in the form of an announcement by the management—perhaps a notice posted on the bulletin boards, perhaps a letter from the operating head, or perhaps at a general plant meeting.

Merely the announcement that a safety director has been appointed is not enough. Management must make clear the position of this individual in the organization. A brief, concise and clear-cut definition of the responsibilities and duties of the safety director will aid greatly in obtaining the proper co-operation of all department heads.

Safety is everyone's responsibility, from the top down. The safety director's position is that of a staff (rather than a line) officer. He sets up an accident prevention program and directs it, advising department heads and management regularly on matters pertaining to the safety of all employes.

8. **Organize Educational Work:** This is one of the big fundamental jobs for the safety director. He must formulate early a program to maintain interest and increase the safety knowledge of management, foremen and workers.

The plant safety committee is the core of our educational program. Most of the important policies are determined by this group which acts as an advisory body for the safety engineer. It also serves as a means of promoting safety-mindedness among all employes.

Our plant committee has just undertaken a very fundamental part of any educational program—the formulation of safety rules.

The size of a safety committee is governed by the size and type of company. If your plant is very small, three men, the manager, the safety director and the plant engineer, may be all that is necessary. If your operations are fairly large, you will wish to include more. Such men as the employment manager, company physician and additional employes are typical members of committees in medium-sized plants.

**Employe-education is essential to the success of the safety program. Posters, such as this one distributed by the National Safety Council, impress employes with the need for safety**

We have conducted classes for workers and supervisory personnel in first aid, fire prevention and safe operating practices. In addition, there have been specialized training courses for members of the fire brigade. All this training work is directed by the safety engineer.

Safety posters are placed regularly on various plant bulletin boards. Articles on safety at home, on the highway and at work are published periodically in the plant newspaper which, incidentally, is edited by the safety engineer.

We know we have just scratched the surface in this phase of our accident prevention program. Much can be done with on-the-job training. For example, foremen as teachers can train men in safe practices as an integral part of over-all job instruction.

There are all sorts of pamphlets, bulletins, pay envelope inserts and other printed materials available today from the various organizations in the safety field.

9. **Obtain Outside Help, Advice, Information:** Here is where organized safety groups can help the manager of the small plant.

A number of sources of information may be consulted. On page R-000 there is a brief summary of the more important agencies. They can supply you with magazines, pamphlets, manuals, posters, safety specifications, rules and laws.

Besides such organizations, you will find it well worth your while to investigate the help industrial compensation counsels can give you. Most states have now established insurance funds to provide compensations for industrial injuries and diseases and have adopted a definite code governing the payment of this compensation.

Because of the legal technicalities arising out of each individual accident case, many plants have found it wise to call on insurance experts and attorneys for help. As a result, a good many lawyers and insurance men have specialized in this field. The advice of these specialists is available to all industrial establishments and we have found it to be well worth the nominal investment it respresents.

10. **Consider Engineering Revision:** Consider methods for improving machinery, equipment and processes so as to eliminate hazards and increase production efficiency.

At their best, safeguards that have been placed on machinery or equipment can only be considered temporary expedients awaiting development of a more fundamental means for eliminating hazards.

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## 10 Steps to Follow in Organizing a Safety Program

1) **Management Assumes the Leadership.** Management adopts an accident-prevention policy and provides the spark to keep it going.
2) **Appoint a Safety Director:** Select one man to direct the safety program. Give him the full responsibility for maintaining it.
3) **Analyze Accident Records.** Study the causes of accidents, past and present, so as to learn where the safety program must be emphasized. Are accidents occurring because of lack of instructions? Because of improper attitude? Because of hazardous machinery? Dig out the "why?"
4) **Inspect Operations.** Look your plant over thoroughly. List all the hazards you can find, then repeat your inspections. Make this a continual program.
5) **Start Mechanical Safeguarding.** Provide guards on hazardous operations —immediately. This action indicates management leadership, a sincere desire on the part of the company to make your plant a safe place in which to work.
6) **Provide First-Aid Facilities.** Be prepared to take care of injuries when they do occur. Show your employes you're interested in their physical well-being.
7) **Make a General Announcement.** Let the employes know that you've decided to stop accidents. Tell them what your plans are and what you expect of them.
8) **Organize Educational Work.** Statistics show that 88% of the accidents are human failures. Education, then is one of the most important fundamental steps. Train the workers to produce efficiently *and* safely.
9) **Obtain Outside Help, Advice, Information.** Don't fail to call on the countless organizations and agencies whose primary function is the supplying of books, posters, pamphlets, inspections and legal advice.
10) **Consider Engineering Revision.** Take the long view on all serious problems of hazards. Look for fundamental changes in methods that will help to eliminate accident causes and improve production efficiency.

## Where To Go for Information

Here are a few of the national organizations whose services are offered to industry to assist in conducting accident prevention programs.

In all cases full details of the services will be sent on request directed to the address shown.

**National Safety Council, Inc.**
20 North Wacker Drive
Chicago 6, Ill.
(Magazines, newsletters, pamphlets, data sheets, payroll enclosures, posters, motion pictures)

**American Petroleum Institute**
Department of Accident Prevention
50 West 50th Street
New York, N. Y.
(Manuals and pamphlets)

**The Manufacturing Chemists Assn.**
608 Woodward Building
Washington, D. C.
(Data sheets on hazardous chemicals and containers)

**Bureau of Labor Statistics**
U. S. Department of Labor
Washington, D. C.

**Division of Labor Standards**
U. S. Department of Labor
Washington, D. C.
(Standards for industrial safeguards. Data sheets on safe practices)

**Bureau of Standards**
U. S. Department of Commerce
Washington, D. C.

**Bureau of Mines**
U. S. Department of Interior
Washington, D. C.

**National Fire Protection Assn.**
60 Batterymarch Street
Boston 10, Mass.
(Magazines, newsletters, manuals, codes, posters, handbooks, all relating to the problem of fire protection)

**National Board of Fire Underwriters**
85 John Street
New York, N. Y.

**American Welding Society**
33 West 39th Street
New York, N. Y.

**American Management Assn.**
330 West 42nd Street
New York, N. Y.

**National Conservation Bureau**
60 John Street
New York, N. Y.

In addition to the above mentioned groups, the following general classification of organizations represents a further source of a wealth of information for the industrial safety program:

State industrial commissions
Insurance companies
Trade associations
Safety equipment manufacturers

preventing power press accidents was the installation of guards to keep the operator's hands away from the descending ram. Then, mechanical means of feeding stock were devised so that it was no longer necessary for the operator's hand to be at the point of operation.

In our own plant, production efficiency was materially increased and a fume hazard greatly reduced by two changes. First, the use of a conveyor was substituted for the original hand feeding of a hazardous chemical. Second, the process method was fundamentally revised. However, neither the raw materials used, the chemical reaction involved nor the quality of the finished product were affected in any way.

Sometimes engineering revision is needed in the layout of a plant. Perhaps the equipment has been moved about because of new processes and a crane well opening is suddenly found directly above a heavily-traveled walkway. At once a serious overhead hazard would exist.

A simple safeguard would be to install a red warning light on the lower level and an automatic trip switch which would turn on the signal light when the crane moved over the floor opening.

However, a safeguard can only be regarded as a temporary expedient. It would not eliminate the possibility of human failure. There is still a chance that someone would ignore the signal and walk under the crane at the precise moment that a load slipped and fell.

Admittedly, the chances are long, but no one wants to gamble his life—even on long odds—especially with nothing to gain.

The ultimate answer would be engineering revision. The layout must be redesigned. Either the crane well or the aisle must be moved.

Obviously, a fundamental engineering revision is not always immediately possible. In the last analysis, however, it does represent the best final answer to the problem of eliminating hazards in the program for accident prevention.

### A Sincere Desire

If you and your employes want to stop accidents, then provide a safe working environment and see to it that there is a safe performance by the workers in that environment. Your safety program will succeed.

It is a permanent job. Don't sit back after a year or two and expect miraculous results. With a little patience, however, you will soon see a satisfying downward sweep in your accident curve. At the same time, there will also be a satisfying upward sweep of your employe morale and you will know you are doing a good job because you are helping to stop the needless waste through accidents that simply don't have to happen.

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# Pierced Plate Contacting Towers Used For Treating with Chemical Solutions

*By D. O. Swan and S. M. Whitehill*

PIERCED plate towers have been found by the Standard Oil Co. of New Jersey to possess many advantages over packed columns or orifice mixing columns for treating hydrocarbons with chemical solutions, as in operations associated with lube oil treating, gas recovery, catalytic and thermal cracking, alkylation and acid extraction.

Advantages for pierced plate towers over the conventional orifice mixing column are: low pressure drop and low operating costs; efficient economical countercurrent extraction; and avoidance of intensive mixing which creates settling difficulties and leads to chemical carryover in the hydrocarbon stream.

In orifice mixing the chemical is normally dispersed in the hydrocarbon and finally dispersed materials such as caustic are difficult to settle. In pierced plate towers the procedure is reversed as the hydrocarbon forms the dispersed phase and usually is easier to settle.

In the pierced plate tower the heavy solution, e.g., caustic soda, is introduced near the top of the tower (above the top plate) and flows in a continuous liquid phase over the plates of the tower to a draw-off connection in the bottom of the tower. The light solution (hydrocarbon) is introduced below the botton plate of the tower through some distribution device such as a perforated pipe.

Bubbles of the light solution, by virtue of their lesser density, travel up countercurrently through the continuous heavy solution phase and are directed through the perforations of the plates by inverted weirs. Space is provided in the top of the tower above the heavy solution inlet for the separation of the light solution from the heavy solution.

### A Typical Tower

A typical example of a pierced plate contacting tower is the caustic wash tower at the Baton Rouge Refinery No. 2 debutanizer and splitter unit. This unit reruns distillates from all the Baton Rouge thermal cracking units, first separating a light naphtha out of the total distillate and then debutanizing the light naphtha.

The light naphtha, consisting of methane and heavier components to 250°F. FBP (approximately 100 lbs RVP), is caustic washed before debutanization to remove $H_2S$. The accompanying flow plan (Fig. 1) illustrates the design of and flow through the contacting tower.

The tower, a 6 ft. x 40 ft. vertical drum, was designed for a maximum pressure of 315 psig at 100° F. and a corrosion allowance of ¼ in. provided. The tower shell and all internal fittings are constructed of carbon steel. There are 15 perforated plates spaced 18 in. apart starting 6 ft. from the bottom of the tower. The plate design specified 2800 perforations of 5/32 in.

*D. O. Swan and S. M. Whitehill are with the Technical Division of the Baton Rouge refinery of Standard Oil Co. of New Jersey, Louisiana Division.*

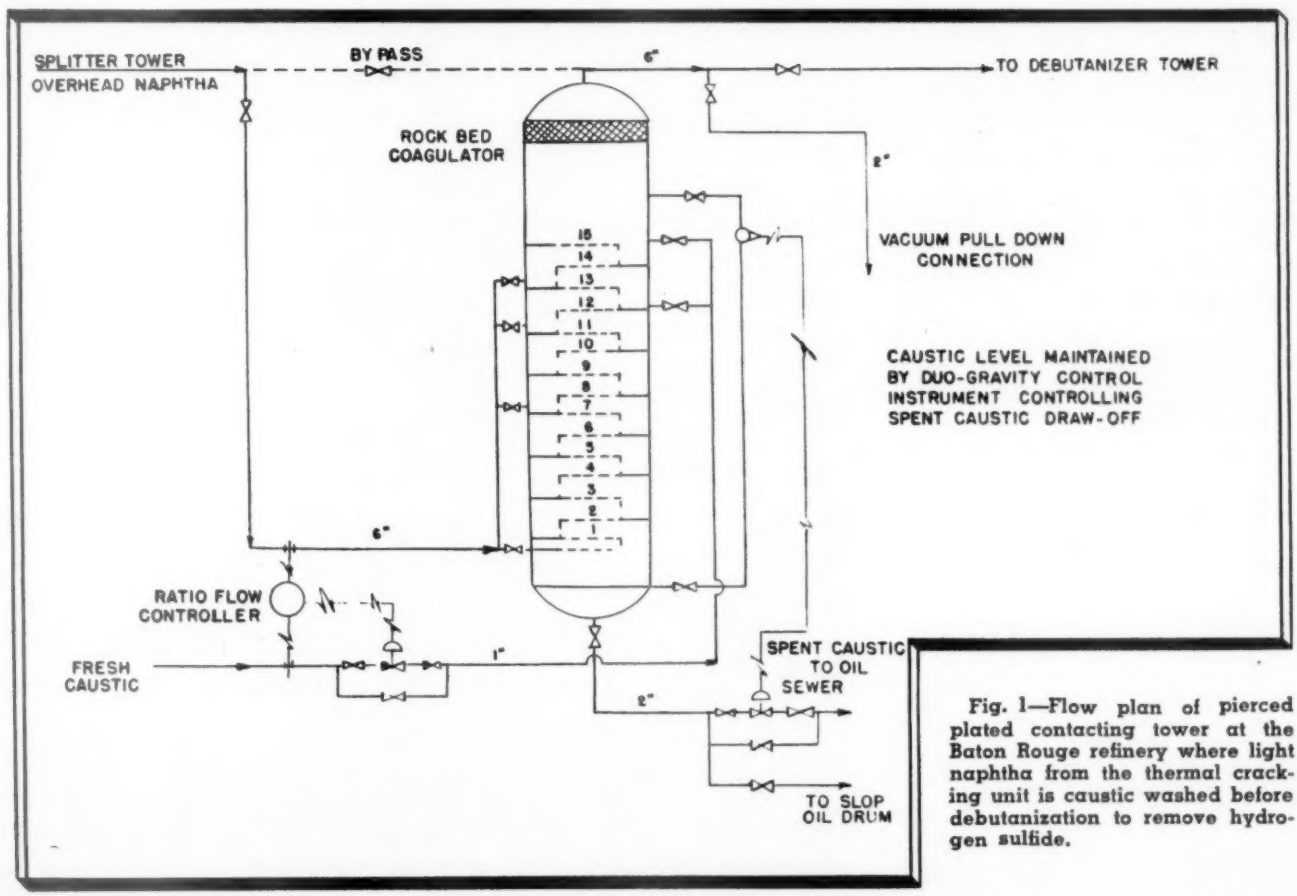


**Fig. 1—Flow plan of pierced plated contacting tower at the Baton Rouge refinery where light naphtha from the thermal cracking unit is caustic washed before debutanization to remove hydrogen sulfide.**

diameter. Each plate is fitted with a segmental downcomer 48¾ in. long at the plate edge, 10 in. wide at the maximum width, and extending 8 in. below the plate. In addition, a weir 2 in. high is placed across each tray directly below the downcomer from the plate above. A bed of fairly coarse rocks (100% pass a ¾ in. mesh screen and 100% retained on ¼ in. mesh screen) one foot thick is installed 8 ft. above the top plate. This rock bed serves to coagulate and retain in the tower any particles of caustic solution in the naphtha.

The tower is protected by a safety valve installed just below the rock bed. Facilities are also provided to evacuate vapors from the tower by way of the refinery vacuum collecting system or to dump oil from the bottom of the tower into a slop drum which is also connected to the vacuum collecting line.

Naphtha is charged to the contacting tower from the discharge of the splitter tower reflux pump. The rate of flow is controlled automatically to maintain a given level in the splitter tower reflux drum. Line pressure on the naphtha is 240 psig before entering the tower and the oil temperature normally 120°F.

### Means of Direct Control

Caustic addition (7° Be NaOH solution) and withdrawal is continuous and is controlled basically to give an $H_2S$ free product to lead acetate test. Direct control of the caustic addition is obtained by means of a ratio-flow controller actuated by the naphtha charge rate. Caustic draw-off is controlled by means of a flow control valve actuated by a duo-gravity level control instrument which maintains a caustic level 3 ft. above the top plate in the tower.

This draw-off control system is designed with the necessary capacity to release quantities of caustic sufficient to compensate for rapid increases in hydrocarbon feed rates. This is necessary because rapid increases in the hydrocarbon rate increases somewhat the hydrocarbon inventory in the tower by increasing the depth of hydrocarbon below each plate.

Caustic is maintained at about 40% spent with respect to $H_2S$ which requires the average addition of from 0.08 to 0.09 lbs. of pure NaOH per barrel of naphtha charge. Copper number inspections of the washed naphtha usually range between two and four.

The Louisiana Division of the Standard Oil Co. of New Jersey has in operation 13 pierced plate towers, the first of which was installed in 1938 to refine lubricating oils by contacting with phenol. Subsequent installations have been made to caustic wash light naphthas (100-115 lbs. RVP) recovered from thermal cracking and gas absorption operations; to wash light hydrocarbons ($C_1$, $C_2$, $C_3$ and $C_4$) from catalytic cracking operations with both caustic and $K_3PO_4$ (in separate towers); to water wash alkylation reactor product streams before fractionation; and both to water wash and caustic wash the residual $C_4$ components from sulfuric acid extraction of isobutylene, the two steps being combined in a single tower—the water introduced into the top of the tower and the caustic solution introduced about midway up the tower.

The pierced plate towers have proved to be efficient countercurrent extraction units and the operating costs are attractively low, especially when compared to the conventional orifice mixing columns.

**Pierced plate caustic wash tower in the debutanizer and splitter unit of the Baton Rouge refinery of the Louisiana Division of Standard Oil Co. of New Jersey. (Photo from the "Water Tower" of Chicago Bridge and Iron Co.)**

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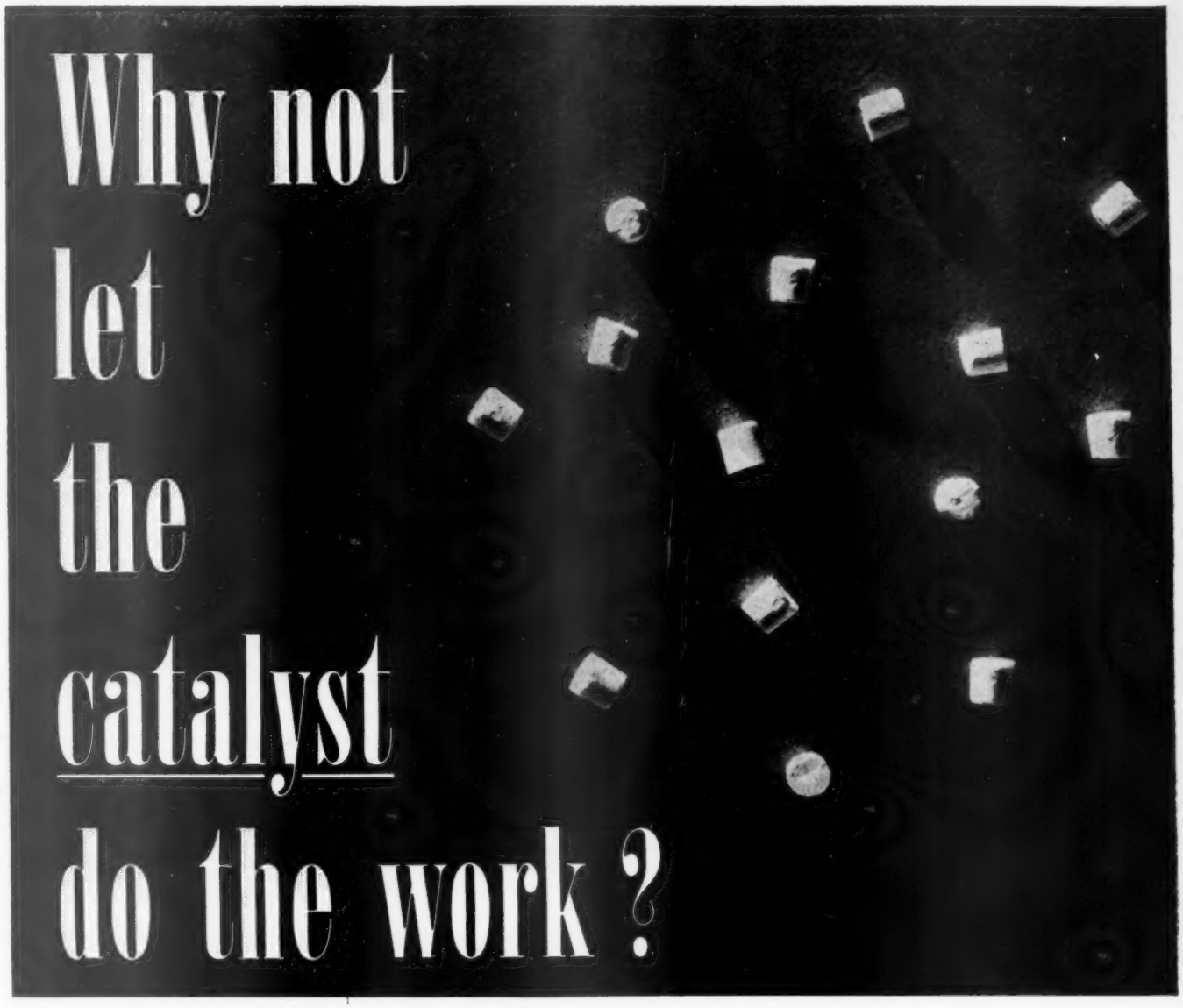

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# Determination of Equilibrium Constants for Butanes and Pentanes

*By Herman Pines, Bruno Kvetinskas, Louis S. Kassel, V. N. Ipatieff*

**The equilibrium constants for "n-butane⇄isobutane" and "n-pentane⇄isopentane" were established by studying the isomerization from both the normal and the isoparaffin side, within wide temperature ranges and under experimental conditions designed to reduce to a minimum the amount of secondary reactions.**

**The results for butane are found to agree with previous equilibrium determinations. The corresponding heat of reaction disagrees with the calorimetric value but the entropy is in fair agreement with the third-law value. The results for pentane disagree with the previous measurements The indicated heat of reaction agrees exactly with the calorimetric value and the agreement with the third-law value is very good.**

In recent years, several papers on the isomerization equilibrium constants of butanes [1, 2] and pentanes [3] have appeared. Most of the work is open to criticism, however, because of the fact that the isomerization was accompanied by excessive decomposition, which even became the predominant reaction in extreme cases.

In the present investigation, the equilibrium constants were established by studying the isomerization from both the normal and the isoparaffin side, within wide temperature ranges and under experimental conditions designed to reduce to a minimum the amount of secondary reactions.

Depending upon the temperature level investigated, the experiments were carried out in sealed tubes, a stirring autoclave, or a continuous flow type apparatus.

### Experimental Methods

The catalysts used consisted of aluminum bromide or aluminum chloride, the latter usually deposited on a carrier. In some instances, a catalyst composed of aluminum chloride-metal halide was used which possessed a high isomerizing activity but caused very little decomposition at elevated temperatures. All of the experiments in which aluminum chloride-containing-catalysts were used were made in the presence of hydrogen chloride.

In order to avoid the formation of undesirable products during isomerization, especially at elevated temperatures, it was found necessary that the contact time between the catalyst and the hydrocarbon be relatively short. This was made possible by using a flow-type apparatus. In the case of pentanes, hydrogen was added to inhibit side reaction.

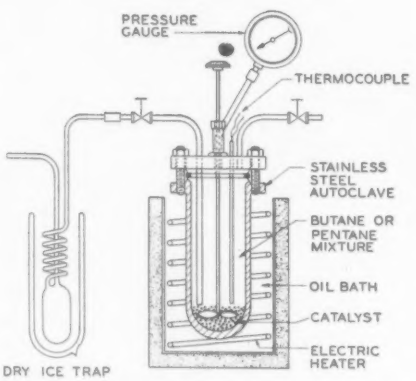


**Fig. 1—Batch apparatus for isomerization of butane or pentane**

The isomerization experiments were made in such a manner as to arrest the reaction at the studied temperatures of isomerization. This was accomplished by removing the catalyst from the product immediately after leaving the reaction zone or by arresting the activity of the isomerizing catalyst by sudden chilling to —76° C.

The composition of the product resulting from isomerization was determined by distillation on a low-temperature Podbielniak apparatus. The efficiency of the distillation was determined from time to time by interjecting synthetic samples having composition approximating the equilibrium mixture of the hydrocarbons studied. The analytical results were accurate within ± 0.8%.

**Batch-Type Apparatus.** — A batch-type apparatus (Fig. 1) consisting of a one-liter capacity, stainless steel pressure autoclave equipped with an electrically driven stirrer was employed to determine the equilibrium of pentanes at 65° C and of butanes at 100° C. The catalyst was sealed in the autoclave, which was then evacuated before the hydrocarbons and hydrogen chloride were charged. In the case of pentanes, hydrogen was added to bring the pressure to 20 atmospheres.

The desired temperature was maintained by means of an electrically heated oil bath. After stirring for a sufficient interval of time, a sample was drawn off (while still at the proper temperature) into a trap cooled with dry ice and acetone, through a tube reaching below the liquid level in the autoclave. The sample was washed with sodium hydroxide, dried with calcium chloride, and analyzed.

**Continuous Flow-Type Apparatus.**— A flow diagram of the apparatus used for determining the equilibrium of pentanes at 150° and 200° C. is shown in Fig. 2. In order to be certain that the catalyst was placed in a position having the least variance of temperature, a heat distribution curve (Fig. 3) was made of the inside temperature and skin temperature when the center of the furnace block was at 150° C. A detailed diagram of the furnace and reaction tube showing the position of the catalyst bed in relation to the furnace temperature is given in Fig. 4.

The pentane mixture was pumped through the catalyst bed while hydrogen chloride and hydrogen were passed in at definite rates through calibrated capillaries. A pressure controller automatically maintained a constant pressure.

At the exit, the product passed through a train consisting of a sodium hydroxide scrubber, a liquid receiver, a calcium chloride drying tower, a dry ice and acetone-cooled trap, a wet-test meter, and a gas sampling bottle.

The product in the liquid receiver was combined with the product condensable in the dry ice and acetone-cooled trap for analysis by low-temperature Podbielniak distillation. A prerun long enough to flush the system completely was allowed before a sample was taken for analysis.

The equilibrium of butanes at 150° C was studied using the same flow-type apparatus described for pentanes, except that the hydrogen chloride was introduced by pumping it in with the butane mixture.

**Butane Equilibrium Results.** — The equilibrium constant for butane isomerization was determined at 25°, 100°, and 150° C.

**Equilibrium Constant at 25° C.**— Samples consisting of aluminum bromide dissolved in a mixture of normal and isobutane were sealed in glass tubes and kept at 25° C. After certain intervals of time, tubes were opened and the mixture, after being washed with sodium hydroxide and dried, was analyzed. The experimental results are given in Table 1.

The reaction time in experiments 1 and 3 was obviously insufficient to reach equilibrium. In experiments 2 and 4, the butane fraction of the product contained 81.6% isobutane. This value

*This paper was presented before the Physical and Inorganic Division of the American Chemical Society, New York, Sept. 11-15, 1944, and was published in the April, 1945, American Chemical Society Journal.*

*The paper is a contribution from the Research Laboratories of the Universal Oil Products Co., with which the authors are connected.*

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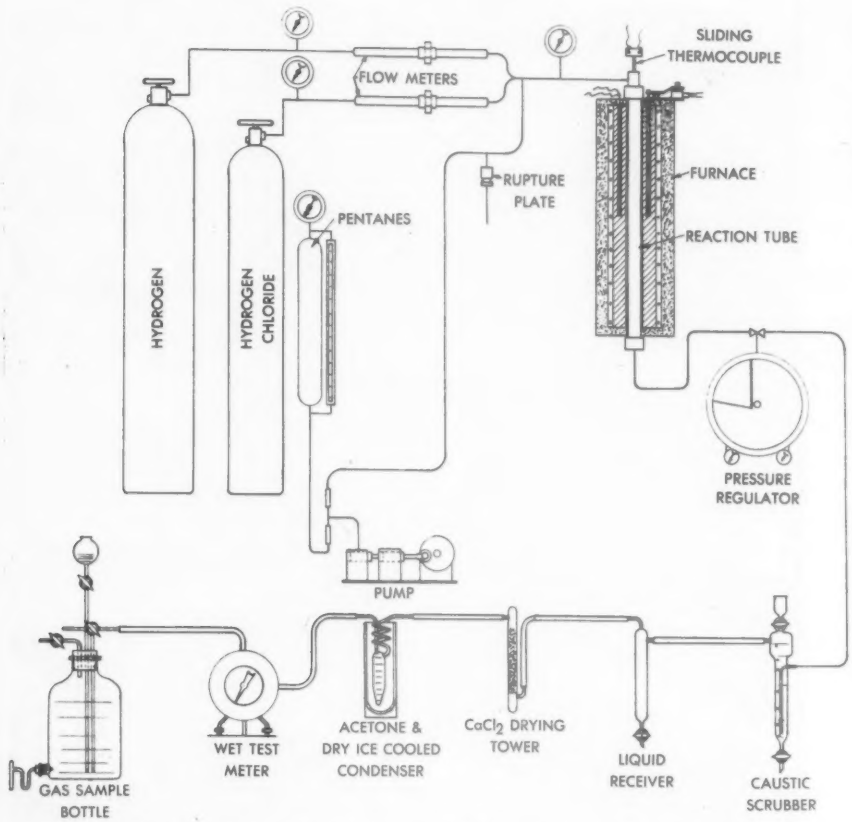



**Fig. 2—Continuous flow type apparatus for isomerization of pentanes**

is assumed to be the equilibrium composition for the liquid phase at 25° C.

**Equilibrium Constant at 100° C.**—The experiments were made in the batch-type apparatus, using aluminum chloride deposited on a carrier. The experimental data are given in Table 2.

Here again the shorter time was inadequate. At the longer contact times, the butane fraction in experiment 6, in which equilibrium was approached from the normal butane side, contained 70.2% isobutane, while the butane fraction of experiment 8, approaching equilibrium from the isobutane side, contained 72.3% isobutane. The average of these values, 71.2% isobutane, is taken as the equilibrium concentration in the liquid phase at 100°.

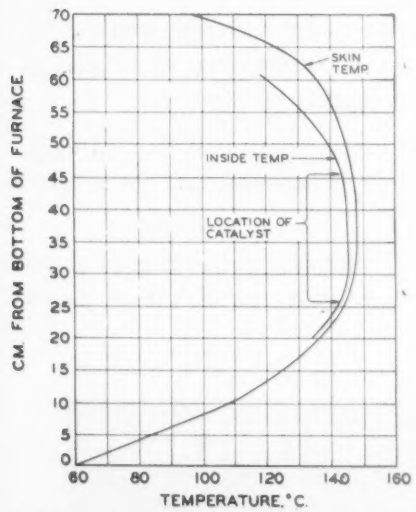



**Fig. 3—Temperature distillation curve for furnace of flow type apparatus**

**Equilibrium Constant at 150° C.**—The reaction was carried out in a flow-type apparatus.

In order to reach equilibrium with a short contact time so as to prevent side reactions, a mixture of *n*-butane and isobutane, having a near equilibrium composition, was passed through a catalyst bed, composed of aluminum chloride deposited on a carrier. The results are given in Table 3.

The composition of the butane fractions produced at the higher space velocities are 66.2% and 62.0% isobutane, the lower value corresponding to approach from the normal butane side. Corresponding values at the lower space velocities are 65.3% and 62.4%. The average of all four values is 64.0% isobutane, but the average of only the latter two, 63.8% isobutane, is believed to be a more reliable value for the equilibrium composition in the vapor phase at 150° C.

**Pentane Equilibrium Results.**—The equilibrium constant for pentane isomerization was determined at 65°, 150° and 200° C.

**Equilibrium Constant at 65° C.**—The isomerization was made in the stirring autoclave in the presence of an aluminum halide-metal halide complex deposited on a carrier. Before the autoclave was heated, hydrogen was added to bring the pressure to 20 atmospheres, in order to eliminate side reactions. The experimental data are given in Table 4.

On the basis of experiments 13 and 14, it is concluded that the equilibrium mixture in the liquid phase consists of 87.2% of isopentane and 12.8% of *n*-pentane.

**Equilibrium Constant at 150° C.**—The experiments were made in the flow-type apparatus at 39 atmospheres and in the presence of an aluminum-metal halide complex deposited on a carrier. The experimental data are given in Table 5.

In each experiment, 52 g. or 80 cc. of 8-12 mesh catalyst was used. The molar ratio of pentane, hydrogen chloride, and hydrogen used was 100:8.8:28.0. The liquid space velocity represents volume of liquid pentane at 20° passed per volume of catalyst per hour. On the basis of experiment 18, period 3 and experiment 19, period 2 it is concluded that the equilibrium mixture at 150° C. consists of isopentane 82.4% and *n*-pentane 17.6%. These experiments were made in a two-phase condition.

**Equilibrium Constant at 200° C.**—The apparatus and procedure used were the same as that described for the experiments made at 150° C. The catalyst employed was an aluminum chloride-metal halide complex deposited on a carrier. Catalysts of various compositions and many experimental conditions were tried in order to reach equilibrium with a minimum amount of decomposi-

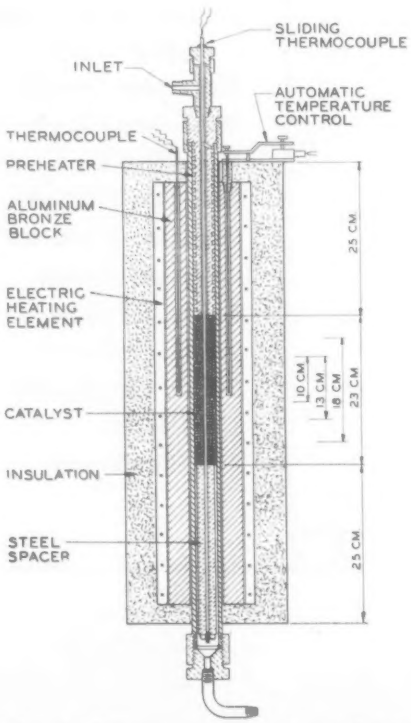



**Fig. 4—Furnace and reaction tube of flow apparatus**

tion. The most satisfactory results are given in Table 6.

On the basis of experiments 22 and 23, in which the charge compositions closely bracketed the equilibrium value, it is concluded that the equilibrium mixture contains 79.0% isopentane and 21.0% *n*-pentane. This value would not be significantly changed if experiment 21 were included in the average.

## Discussion of Results

**Isomerization of Butane.**—It is desirable to reduce the experimental data to $K_G^\circ$, the vapor phase equilibrium constant at zero pressure. No phase equilibrium or *P-V-T* data on mixtures of normal and isobutane are available, but it is possible to use the data on the individual hydrocarbons with the assistance of plausible assumptions regarding the behavior of the mixture.

It is assumed that in liquid mixtures of normal and isobutane the fugacity of each component is equal to the fugacity of the pure material at the same temperature and pressure times the mol fraction of that component. It is further assumed that the fugacities of both components are equally affected by the minor amounts of dissolved catalysts, hydrogen chloride, and hydrogen. Then:

$$K_G^\circ = K_L\left(\frac{f_I e^{(P-P_I)V_I/RT}}{f_N e^{(P-P_N)V_N/RT}}\right)$$

where $f_N$, $f_I$ are fugacities of liquid normal, and isobutane at temperature $T$, and at their respective vapor pressure $P_N$, $P_I$, $V_N$, $V_I$ are the molar volumes of the liquids, and $P$ is the total experimental pressure. Values of $f_N$ and $V_N$ are taken from the work of Sage, Webster and Lacey[4] and values of $f_I$ and $V_I$ from Sage and Lacey[5]. The values of $V_N$ and $V_I$ are so nearly the same that the correction factor is almost independent of the total pressure, $P$. At 110° C., the factor changes by 1% for a change of about 18,000 mm. in $P$, and at lower temperatures it is even less sensitive. It is therefore considered sufficient to calculate $K_G^\circ/K_L$ at the estimated total butane pressure without correction for other components. Values so obtained are shown in the first part of Table 7 along with the vapor pressure ratios. It is clear that use of vapor pressures in Raoult's Law would be unsatisfactory.

The vapor phase equilibrium constants are substantially independent of pressure. It is expected that $K_G$ will be reduced as the pressure is increased, but approximate calculations suggest that the change cannot exceed 2% except for extremely high pressures attainable only above the 150° C. This correction is therefore ignored.

The summarized results of this work are compared with equilibrium determinations of Moldavskii and Nizovkina,[1] Montgomery, McAteer and Franke[6]

TABLE 1—$n$-$C_4H_{10} \rightleftarrows i$-$C_4H_{10}$ at 25° C.

| Expt. No. | Reactant Hydrocarbons: Grams | % *i*-$C_4H_{10}$ | % *n*-$C_4H_{10}$ | $AlBr_3$ Grams | Contact Time, Days | Analysis of Prod. Mol-%: $C_3H_8$ | *i*-$C_4H_{10}$ | *n*-$C_4H_{10}$ | $C_5H_{12}$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 49.2 | 90.1 | 9.9 | 19.4 | 37 | .. | 85.7 | 14.3 | . |
| 2 | 47.9 | 90.1 | 9.9 | 19.3 | 678 | .. | 80.5 | 18.1 | 1.4 |
| 3 | 48.8 | 50.5 | 49.5 | 19.4 | 33 | .. | 57.2 | 42.8 | .. |
| 4 | 48.9 | 50.5 | 49.5 | 19.2 | 670 | 0.9 | 80.2 | 18.1 | 1.4 |

TABLE 2—$n$-$C_4H_{10} \rightleftarrows i$-$C_4H_{10}$ at 100° C.

| Expt. No. | Charge to Autoclave: % *i*-$C_4H_{10}$ | % *n*-$C_4H_{10}$ | Grams $C_4H_{10}$ | Grams HCl | Catalyst, Grams | Contact Time, Hrs. | Analysis of Prod. Mol-%: $C_3H_8$ | *i*-$C_4H_{10}$ | *n*-$C_4H_{10}$ | $C_5H_{12}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 0 | 100 | 114 | 5 | 30.0 | 4 | 0.4 | 30.6 | 67.5 | 1.5 |
| 6 | 50 | 50 | 118 | 5 | 53.2 | 21 | .. | 68.7 | 29.2 | 2.1 |
| 7 | 100 | 0 | 110 | 4 | 54.2 | 4 | . | 96.9 | 2.1 | 1.0 |
| 8 | 85.7 | 14.3 | 134 | 5 | 54.0 | 25.5 | 1.4 | 68.8 | 26.4 | 3.4 |

TABLE 3—$n$-$C_4H_{10} \rightleftarrows i$-$C_4H_{10}$ at 150° C.

| Expt. No. | Butane Mixture Chgd.: *n*-$C_4H_{10}$ | *i*-$C_4H_{10}$ | $C_5H_{12}$ | Liq. Space Vel. | Analysis of Prod. Mol-%: $C_3H_8$ | *i*-$C_4H_{10}$ | *n*-$C_4H_{10}$ | $C_5H_{12}$ |
|---|---|---|---|---|---|---|---|---|
| 9 | 69.3 | 30.4 | 0.3 | 1.1 | 0.8 | 65.5 | 33.5 | 0.2 |
| 10 | 69.3 | 30.4 | 0.3 | 0.57 | 1.3 | 63.9 | 33.9 | 0.9 |
| 11 | 52.2 | 47.4 | 0.4 | 1.0 | 1.4 | 61.0 | 37.4 | 0.2 |
| 12 | 52.2 | 47.4 | 0.4 | 0.5 | 1.8 | 60.3 | 36.4 | 1.5 |

The experiments were made at 99 atmos. pressure using 4 mol. % of hydrogen chloride based on butanes and 80 cc. catalysts.

TABLE 4—$n$-$C_5H_{12} \rightleftarrows i$-$C_5H_{12}$ at 65° C.

| Expt. No. | Charge, %°: *i*-$C_5H_{12}$ | *n*-$C_5H_{12}$ | Contact Time, Hours | Prod. on $C_5$: *i*-$C_5H_{12}$ | Mol-% Basis: *n*-$C_5H_{12}$ | % Decomposition |
|---|---|---|---|---|---|---|
| 13 | 90 | 10 | 16.5 | 87.9 | 12.1 | 0.8 |
| 14 | 80 | 20 | 24.5 | 86.5 | 13.5 | 2.1 |
| 15 | 75 | 25 | 39.0 | 84.5 | 15.5 | 1.1 |
| 16 | 100 | 0 | 27.0 | 89.3 | 10.7 | 0.9 |

°In each experiment 80 g. total pentanes, 35.5 g. of catalyst, and 9-10 g. of hydrogen chloride were used.

TABLE 5—$n$-$C_5H_{12} \rightleftarrows i$-$C_5H_{12}$ at 150° C.

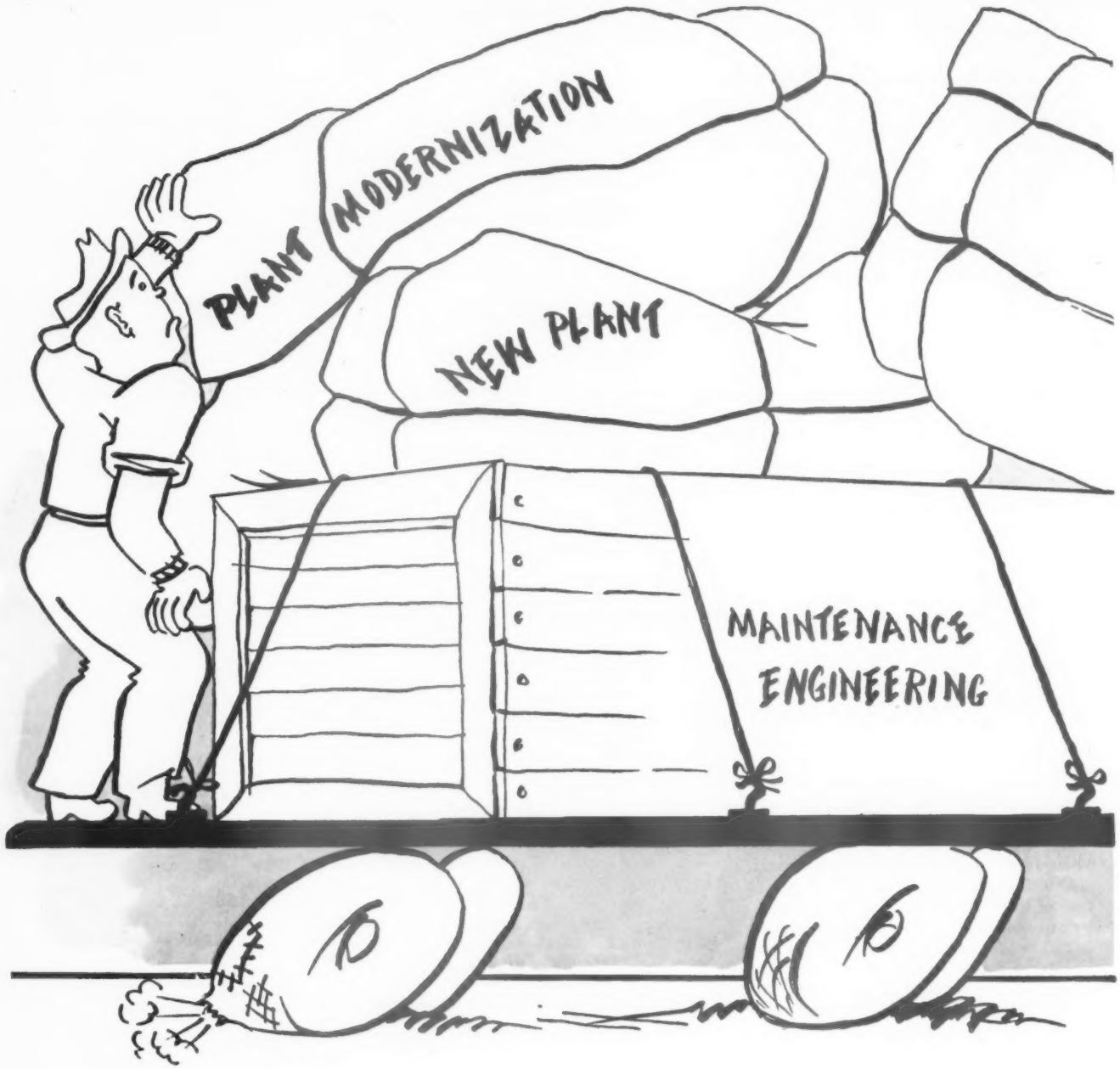
| Expt. No. | Period | Charge, %: *i*-$C_5H_{12}$ | *n*-$C_5H_{12}$ | Liq. Space Vel. | Product Mol-% Calculated On Pentane Basis: *i*-$C_5H_{12}$ | *n*-$C_5H_{12}$ | Mol-% Decomposition |
|---|---|---|---|---|---|---|---|
| 17 | 2 | 100 | 0 | 0.53 | 90.5 | 9.5 | 0.4 |
| | 3 | 100 | 0 | 0.43 | 91.3 | 8.7 | 0.6 |
| 18 | 2 | 90 | 10 | 0.49 | 84.7 | 15.3 | 3.0 |
| | 3 | 90 | 10 | 0.63 | 82.6 | 17.4 | 0.6 |
| 19 | 2 | 79.5 | 20.5 | 0.47 | 82.3 | 17.7 | 1.0 |
| | 3 | 79.5 | 20.5 | 0.38 | 82.2 | 17.8 | 1.0 |
| 20 | 2 | 75 | 25 | 0.62 | 80.5 | 19.5 | 3.1 |
| | 3 | 75 | 25 | 0.50 | 80.1 | 19.9 | 2.1 |

TABLE 6—$n$-$C_5H_{12} \rightleftarrows i$-$C_5H_{12}$ at 200° C.

| Expt. No. | Charge, %: *i*-$C_5H_{12}$ | *n*-$C_5H_{12}$ | Liquid Space Velocity | Product, Mol-% Calculated on Pentane Basis: *i*-$C_5H_{12}$ | *n*-$C_5H_{12}$ | Mol-% Decomposition |
|---|---|---|---|---|---|---|
| 21 | 90 | 10 | .50 | 79.6 | 20.4 | 2.6 |
| 22 | 84 | 16 | .33 | 80.7 | 19.3 | 1.9 |
| 23 | 75 | 25 | .45 | 77.3 | 22.7 | 1.4 |

TABLE 7—Isomerization of Butane

| Temperature °C | $K_G^\circ/K_L$ | $P_I/P_N$ | Mol-% *i*-$C_4H_{10}$: Liquid | Vapor |
|---|---|---|---|---|
| 20 | 1.410 | 1.439 | 81.7 | 86.3 |
| 25 | 1.395 | 1.426 | 80.9 | 85.5 |
| 30 | 1.378 | 1.412 | 80.0 | 84.7 |
| 40 | 1.348 | 1.389 | 78.4 | 83.0 |
| 50 | 1.319 | 1.368 | 76.8 | 81.3 |
| 60 | 1.290 | 1.350 | 75.2 | 79.6 |
| 70 | 1.264 | 1.334 | 73.6 | 77.9 |
| 80 | 1.238 | 1.319 | 72.1 | 76.2 |
| 90 | 1.215 | 1.306 | 70.7 | 74.5 |
| 100 | 1.193 | 1.294 | 69.2 | 72.9 |
| 110 | 1.175 | 1.282 | 67.8 | 71.2 |
| 120 | | | | 69.6 |
| 130 | | | | 68.0 |
| 140 | | | | 66.5 |
| 150 | | | | 65.0 |

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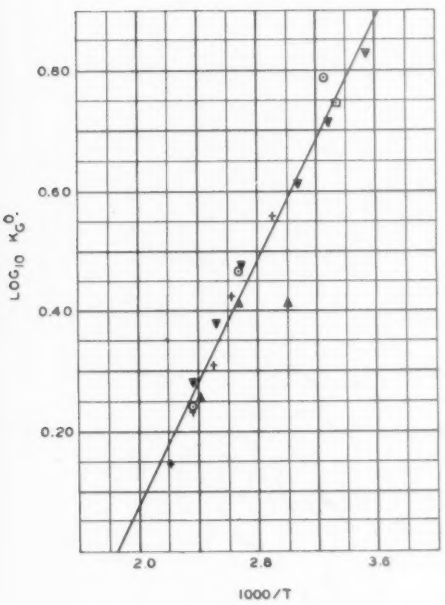


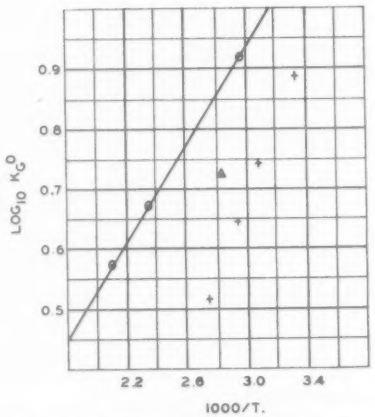


**Fig. 5 (left)—Experimental values of $K_G°$ for isomerization of butane: ⊙, this work; +, Moldavskii, et al.; □, Montgomery, et al.; △, Schuit, et al.; ▼ Horne**

**Fig. 6 (above)—Experimental values of $K_G°$ for isomerization of pentane: ⊙, this work; +, Moldavskii, et al.; △, Schuit, et al.**

Schuit, Hoog and Verheus [2], and Horne [7] in Table 8 and Fig. 5. The results of Schuit et al are obviously wrong at 60° C, and too discordant at 140° C to receive serious consideration. Their value at 100° C, and all values of other observers agree within a maximum deviation of 3% in composition with values based on the equation.

$$R \ln K_G° = \frac{2318}{T} - 4.250$$

The corresponding value of 2318 cal./mol for the heat of isomerization of butane is markedly higher than the value of 1640 cal./mol determined by Rossini [8] from heats of combustion. The probable error of the value derived from equilibrium constants is less than 100 cal./mol, and there seems to be no doubt that the thermochemical value is incorrect. This same conclusion was reached previously by Frost [9] and by Messerly, Aston and Kennedy [10] as a result of calculations of the same character as those made here. The accumulation of additional equilibrium data has served merely to strengthen this conclusion.

The value of 4.25 e.u. for the entropy of isomerization is somewhat higher than the figure of 3.57 e.u. calculated by difference from the third-law values of Aston and Messerly [11] for normal butane and of Aston, Kennedy, and Schumann [12] for isobutane, but the agreement is almost as good as could be expected, in view of estimated errors of 0.35 e.u. for the third-law value, and 0.25 e.u. for the value from equilibrium constants.

Calculated values for the mol-% of isobutane at equilibrium are given in Table 7. It has not been considered desirable to tabulate extrapolated values. It is of interest to note, however, that at 500° C. K. = 0.53 with an estimated uncertainty of 20%, and the equilibrium mixture contains 35 (± 4) % isobutane. The predominant occurrence of isobutane in products of catalytic cracking and destructive hydrogenation, therefore, must be interpreted in terms of reaction rates.

**Isomerization of Pentane.**—The procedure used to convert $K_L/K_G°$ is the same as for the butanes. The fugacities for liquid isopentane were calculated from the data of Young [13] and Young and Thomas [14]; values for normal pentane were taken from Sage and Lacey [15]. The final factors are given in the first part of Table 9.

The runs made at 150° C. were probably in a two-phase region. Values of the vaporization equilibrium constants for this system are not known, but may be estimated as follows:

| | |
|---|---|
| $n$-$C_5H_{12}$ | .6843 |
| $i$-$C_5H_{12}$ | .7500 |
| HCl | 4.3 |
| $H_2$ | 6.4 |

These estimates are based on data of Nelson and Bonnell [16] for hydrogen, and on data of Ottenweller, Holloway, and Weinrich [17], together with unpublished data from this laboratory for HCl, with considerable extrapolation in both cases. The value for isopentane is the usual estimate, and the ratio of the values for the pentane isomers conforms to the requirement of Table 9. The calculated compositions of the two phases

**TABLE 8—Isomerization of Butane**

| Observer | Temp. °C. | Observed $K_G°$ | Observed Phase | % Isobutane in Observed Phase: Calc. | Obs. | | | |
|---|---|---|---|---|---|---|---|---|
| This Work | 25 | 6.18 | Liquid | 80.8 | 81.3 | 81.6 | .... | .... |
| | 100 | 2.95 | Liquid | 69.2 | 70.2 | 72.3 | .... | .... |
| | 150 | 1.76 | Vapor | 65.0 | 62.4 | 65.3 | .... | .... |
| Moldavskii | 70 | 3.61 | Liquid | 73.6 | 73.9 | 74.3 | .... | .... |
| | 110 | 2.64 | Vapor | 71.2 | 71.7 | 73.4 | .... | .... |
| | 130 | 2.04 | Vapor | 68.0 | 66.9 | 67.3 | .... | .... |
| | 150 | 1.73 | Vapor | 65.0 | 63.1 | 63.8 | .... | .... |
| | 180 | 1.41 | Vapor | 60.7 | 58.0 | 58.0 | 59.0 | .... |
| Montgomery | 27 | 5.55 | Liquid | 80.6 | 78 | 82 | .... | .... |
| Schuit | 60 | 2.62 | Liquid | 75.2 | 64.5 | 66.3 | 67.6 | 68.4 |
| | 100 | 2.62 | Liquid | 69.2 | 67.1 | 67.9 | 69.0 | 71.2 |
| | 140 | 1.82 | Vapor | 66.5 | 60.4 | 62.3 | 64.5 | 69.6 |
| Horne | 10 | 6.69 | Vapor | 87.9 | 87.0 | ±1.0 | .... | .... |
| | 30.3 | 5.25 | Vapor | 84.6 | 84.0 | ±0.8 | .... | .... |
| | 52 | 4.13 | Vapor | 81.0 | 80.5 | ±0.8 | .... | .... |
| | 99 | 3.00 | Vapor | 73.0 | 75.0 | ±1.2 | .... | .... |
| | 123 | 2.37 | Vapor | 69.1 | 70.3 | ±1.0 | .... | .... |
| | 150 | 1.90 | Vapor | 65.0 | 65.5 | ±1.2 | .... | .... |

**TABLE 9—Isomerization of Pentane**

| Temperature °C | $K_G°/K_L$ | $P_I/P_N$ | Mol-% $i$-$C_5H_{12}$: Liquid | Vapor |
|---|---|---|---|---|
| 60 | 1.225 | 1.266 | 87.6 | 89.6 |
| 70 | 1.209 | 1.250 | 86.8 | 88.6 |
| 80 | 1.193 | 1.234 | 86.1 | 88.1 |
| 90 | 1.178 | 1.218 | 85.3 | 87.3 |
| 100 | 1.162 | 1.203 | 84.6 | 86.5 |
| 110 | 1.149 | 1.191 | 83.9 | 85.7 |
| 120 | 1.135 | 1.178 | 83.2 | 84.9 |
| 130 | 1.122 | 1.167 | 82.5 | 84.1 |
| 140 | 1.109 | 1.159 | 81.9 | 83.4 |
| 150 | 1.096 | 1.151 | 81.3 | 82.6 |
| 160 | | | | 81.9 |
| 170 | | | | 81.1 |
| 180 | | | | 80.4 |
| 190 | | | | 79.7 |
| 200 | | | | 79.0 |

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| | | |
|---|---|---|
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| *CATALYTIC REFORMING* | *THERMAL REFORMING* | *POLYTREATING* |
| *HYDROGENATION* | *HYDROFORMING* | *U. O. P. CATALYSTS* |
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conforming to these values and the observed total composition are:

| | Mols Liquid | Vapor | Total |
|---|---|---|---|
| $i$-$C_5H_{12}$ .. | 13.589 | 68.811 | 82.400 |
| $n$-$C_5H_{12}$ .. | 3.132 | 14.468 | 17.600 |
| HCl ..... | .293 | 8.507 | 8.800 |
| $H_2$ ..... | .633 | 27.367 | 28.000 |
| | 17.647 | 119.153 | 136.800 |

hence $K_L = 4.34$

$K_G = 4.76$

The summarized results of this work are compared with equilibrium determinations of Schuit, Hoog, and Verheus [2] and of Moldavskii, Nizovkina, and Shterner [3] in Table 10. The large apparent errors in the older work are probably due mainly to excessive side reactions. In the work of Moldavskii and Nizovkina only 20-35% of the charge remained in the pentane fraction, the rest being converted to lighter and heavier fractions. The calculated values are therefore based on the equation:

$$R \ln K_G^\circ = \frac{1861}{T} - 1.299$$

which has been fitted only to the present results. The corresponding value of 1861 cal./mol for the heat of isomerization is in perfect agreement with the value of 1930 cal./mol given by Rossini [8]. The value of 1.30 e.u. for the entropy of isomerization is also in excellent agreement with the value of 1.12 e.u. based on third-law measurements of Messerly and Kennedy [18] for normal pentane and of Schumann, Aston, and Sagenkahn [19] for isopentane.

It has been pointed out that all our measurements on pentane isomerization were made with hydrogen as a cracking suppressant, and that this may produce a dynamic steady state different from the true equilibrium. We are unable to give a scientifically rigorous answer to this criticism. Whenever practically irreversible side reactions are encountered, only these dynamic steady states can be measured. It is thermodynamically possible for a slow side reaction with a large free energy decrease to produce a shift from true equilibrium to steady state which is out of all proportion to the amount of the side reaction. For example, consider the reaction scheme:

$$A \rightarrow B \ldots\ldots\ldots\ldots\ldots\ldots k_1 \quad [A]$$
$$B \rightarrow A \ldots\ldots\ldots\ldots\ldots\ldots k_2 \quad [B]$$
$$(n+1)A \rightarrow nB + C \ldots\ldots\ldots\ldots k_3 \quad [A]$$

where the third reaction represents an irreversible formation of $C$ from $A$, coupled with the isomerization of $n$ molecules of $A$, to give an over-all free energy decrease. This scheme gives a dynamic steady state:

$$K_1' = \frac{[B]}{[A]} = \frac{k_1 + (n+f)k_3}{k_2}$$

where $o < f < 1$

TABLE 10—Isomerization of Pentane

| Observer | Temp. °C. | Observed $K_G^\circ$ | Observed Phase | Calc. | % Isopentane In Observed Phase — Obs. | | |
|---|---|---|---|---|---|---|---|
| This work | 65 | 8.29 | Liquid | 87.2 | 86.5 | 87.9 | |
| | 150 | 4.76 | Mixed | 82.4 | 82.2 | 82.6 | |
| | 200 | 3.76 | Vapor | 79.0 | 77.3 | 79.0 | 80.7 |
| Moldavskii | 25 | 7.70 | Liquid | 90.4 | 85.7 | 85.8 | |
| | 50 | 5.55 | " | 88.4 | 81.5 | 82.0 | |
| | 70 | 4.44 | " | 86.8 | 77.7 | 79.5 | |
| | 90 | 3.32 | " | 85.3 | 73.0 | 73.5 | 75.0 |
| Schuit | 80 | 5.37 | Liquid | 86.1 | 81.0 | 82.5 | |

The true equilibrium constant is of course:

$$K_1 = \frac{[B]}{[A]} = \frac{k_1}{k_2}$$

The ratio is:

$$\frac{K_1'}{K_1} = 1 + (n+f)\frac{k_3}{k_1}$$

The free energy increase in converting $n$ mols of $A$ to $B$ at steady state conditions is:

$$nRT\ln = 1 + (n+f)\frac{k_3}{k_1}$$

The free energy decrease in converting one mol of $A$ to $C$ is

$$RT\ln f$$

where $F$ is the ratio of the thermodynamic equilibrium concentration of $C$ (with respect to $A$) to the actual concentration. The maximum possible value of $n$ is then given by:

$$\left[1 + (n+f)\frac{k_3}{k_1}\right]^n = F$$

When $F$ is large and $k3/k1$ is small, values of $n$ in the range 10-100 or even more are thermodynamically possible, and the steady state may be far from the true equilibrium. Almost all equilibrium measurements involving organic compounds are subject to this type of error. The efficient coupling of reactions assumed here, however, is virtually unknown in practice. When the amount of side reaction is large, it does not require such coupling to produce a seriously false steady state. It is considered a reasonable presumption, therefore, that the use of hydrogen, which greatly reduces side reaction, gives improved values for the pentane isomerization equilibrium.

## Summary

(1) The isomerization equilibria for butane and pentane have been studied under conditions of only slight side reactions.

(2) The results for butane agree with previous equilibrium determinations, and may be represented by

$$R \ln K_G^\circ = \frac{2318}{T} - 4.250$$

The corresponding heat of reaction disagrees with the calorimetric value, but the entropy is in fair agreement with the third-law value.

(3) The results for pentane disagree with the previous measurements, and lead to the equation

$$R \ln K_G^\circ = \frac{1861}{T} - 1.299$$

The indicated heat of reaction agrees exactly with the calorimetric value, and the agreement with the third-law entropy is very good.

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# Developments in Azeotropic and Extractive Distillation Reviewed in Symposium

## Current Interest in Rapidly Developing Field Evidenced at Philadelphia Meeting; Topics Range from Theoretical Aspects to Esterification of Butanol with Acetic Acid

EVIDENCING the current interest in the rapidly developing field of azeotropic and extractive distillation, 400 chemical engineers heard a symposium of six papers at the meeting of the Philadelphia-Wilmington section of the American Institute of Chemical Engineers at Philadelphia on April 12.

Robert R. White, assistant professor, Department of Chemical and Metallurgical Engineering, University of Michigan, presided. The following papers were presented:

"Extractive and Azeotropic Distillation. I. Theoretical Aspects"; by Manson Benedict and Louis C. Rubin, The M. W. Kellogg Co., Jersey City, N. J.

"Vapor Liquid Equilibria of Non-ideal Solutions"; by Dr. White.

"Extractive Distillation of Hydrocarbons with Phenol"; by H. G. Drickamer, Pan-American Refining Co., Texas City, Tex.

"The Selection of Separating Agents for Azeotropic and Extractive Distillation and for Liquid-Liquid Extraction"; by A. P. Colburn and E. M. Schoenborn, the University of Delaware, Newark, Del.

"Extractive and Azeotropic Distillation. II. Separation of Toluene from Paraffin by Azeotropic Distillation with Methanol"; by C. A. Johnson, R. Solomon, L. C. Rubin, and Manson Benedict, The M. W. Kellogg Co.

"Continuous Esterification of Butanol with Acetic Acid. I. Kinetic and Distillation Considerations"; by C. E. Leyes and D. F. Othmer, Polytechnic Institute of Brooklyn.

Dr. Benedict in his paper on "Extractive and Azeotropic Distillation. I. Theoretical Aspects", defined and described typical extractive and azeotropic distillation processes and differentiated between the two.

He defined extractive distillation as distillation in the presence of a substance which is relatively non-volatile compared to the components to be separated and which, therefore, is charged continuously near the top of the distillation column so that an appreciable concentration is maintained on all points of the column.

Azeotropic distillation was defined as a process in which the substance added forms an azeotrope with one or more of the components and by virtue of this fact is present on most of the places on the column in appreciable concentrations.

The example cited of extractive distillation was the separation of butene-2 from *n*-butene by means of acetone as a solvent. The large extractive column consists of three sections, the solvent recovery section, the absorbing section, and the stripping section. The solvent is charged continuously at the top of the absorbing section and flows through this section and the stripping section, and is found in appreciable concentration in the liquid on all trays below the point of solvent feed.

Hydrocarbon feed is charged at some point below the solvent feed and is separated into overhead and bottoms in the absorbing and stripping sections, owing to the presence of appreciable concentrations of solvent. Solvent and bottoms are withdrawn from the bottom of the extractive tower and separated in the bottoms stripping tower, the solvent-free bottoms being removed as the overhead and the stripped solvent being returned to the extractive tower.

Since the solvent usually has an appreciable volatility, it is necessary to add the solvent recovery section at the top of the extractive tower to separate between solvent and overhead.

### Azeotropic Distillation Process

The azeotropic distillation process was exemplified by the use of nitro-methane in the separation of toluene from paraffinic hydrocarbons of substantially the same boiling point. In this process hydrocarbon feed, together with a small proportion of the azeotrope of nitromethane and toluene, is charged as feed to the tower. This tower is refluxed at the top with a mixture of paraffin and solvent in sufficient proportion to insure the presence of solvent in most of the trays of the tower. Under these conditions the azeotrope of paraffin and nitro-methane is taken off as overhead product.

When this mixture is condensed and cooled, it separates into two liquid layers. The bottom solvent-rich layer is returned to the azeotropic tower and the upper paraffin-rich layer is divided into two parts, part returning to the azeotropic tower as hydrocarbon reflux and the balance being sent to the overhead solvent stripping tower where the overhead of paraffin is taken off as bottoms and the azeotrope of paraffin and solvent is taken off as overhead and returned to the tower.

Dr. Benedict pointed out the similarity between azeotropic and extractive distillation in that both add solvent which forms non-ideal solutions, with one or both of the components being separated, and thereby exaggerates the difference in volatility between them.

The processes differ in the means used to maintain the desired solvent concentration of the plates of the columns. In extractive distillation this is accomplished by virtue of the non-volatility of the solvent and the fact that it is charged to the point high up in the column. In azeotropic distillation the solvent is relatively volatile and usually forms an azeotrope with one or both of the components being separated. In extractive distillation the solvent is necessarily removed from the bottom of the column whereas in azeotropic distillation most of the solvent is removed overhead.

The advantages of extractive distillation are the relative ease with which solvents can be found, the greater flexibility of operation permitted, and the relatively small amount of energy required.

Dr. Benedict then proceeded to a discussion of the phase relationships of typical extractive and azeotropic systems and showed the application of the McCabe-Thiele diagram in following solvent concentrations through the different sections of the tower. He also demonstrated the method of Bonilla[1] in calculating the composition and plate requirements for these operations. This development showed clearly the importance of various factors such as selectivity, volatility, capacity, and separability of solvents from non-solvents in the design of extractive or azeotropic distillation.

### Vapor-Liquid Equation

In his paper on "Vapor-Liquid Equilibria of Non-Ideal Solutions," Dr. White pointed out that all technical considerations involved in the design and operation of azeotropic and extractive distillation equipment were based fundamentally on a knowledge of the vapor-liquid equilibrium data, then suggested a general equation to describe the vapor-liquid equilibrium relationships of non-ideal solutions.

This relation was derived from the van der Waal equation of state as applied to mixtures. The resulting general equation when applied to binary mixtures gave the familiar van Laar[3] equation, as presented by Colburn and Carlson.[2]

After reviewing the correlation of equilibrium data from binary systems, the application of the general equation in correlating ternary data was described. The prediction of ternary and multicomponent data from binary data was considered and the application of the equations to the prediction of data for the systems, benzene-ethanol-water, ethanol-water-cellosolve, and methanol-ethanol-water was shown to give satisfactory

agreement with experimental data.

The third paper, "Extractive Distillation of Hydrocarbons with Phenol," presented by Mr. Drickamer, gave experimental data on the binary systems iso octane-toluene, phenol-toluene, methocyclohexane-phenol, and iso octane-phenol. Also included were experimental data for the ternary systems methocyclohexane-toluene-phenol, iso octane-toluene-phenol, and isononane-toluene-phenol; and the quartenary system iso octane-methocyclohexane-toluene-phenol.

These data were correlated by the equation presented by Dr. White, and in addition empirical relations of the same general form were proposed for the extension of these data to other hydrocarbon systems. Mr. Drickamer then discussed the application of equilibrium data to the analysis of test results of a commercial unit separating toluene from petroleum fractions with phenol.

The commercial test data were analyzed by making tray-to-tray calculations using the equilibrium data. These calculations demonstrated a remarkable agreement between the calculated and the experimentally determined composition profile for the column. The overall tray efficiency for this tower averaged about 50% for the toluene recovery tower and about 45% for the stripper efficiency.

Mr. Drickamer also showed the application of the McCabe-Thiele method in the analysis of the toluene tower and the stripper. Vapor-liquid equilibrium data run on tray samples from this tower checked the calculated results and the predicted results from previous correlations remarkably well and demonstrated the usefulness of this procedure as a design method.

### Separating Agents

In the paper on "Selection of Separating Agents for Azeotropic and Extractive Distillation", Prof. Colburn reviewed the criteria for the choice between the use of distillation and liquid-liquid extraction for the separation of close-boiling fractions, comparing the equations for relative volatility in vapor-liquid systems with that for relative volatility in liquid-liquid systems.

After reviewing the calculation of constants for the van Laar equations from vapor-liquid equilibrium data he also showed the calculation of these constants for solubility data and presented a new chart to facilitate these calculations. The estimation of ternary relationships from binary data was then discussed and the applications and limitations of the linear interpolation method between the activity coefficients of the separate binary systems was shown.

The conclusion to this discussion was that the linear interpolation method was applicable and satisfactory in some systems but unsatisfactory in others, as demonstrated with the systems methanol-ethanol-water, methocyclohexane-*n*-heptane-aniline, ethanol-benzene-water, butanol-butyl acetate-water, ethanol-water-dioxane, and ethanol-water-cellosolve.

### Distillation with Methanol

Dr. Benedict presented the fifth paper, "Extractive and Azeotropic Distillation, II. Separation of Toluene from Paraffin by Azeotropic Distillation with Methanol". He showed the application of the same general type relations as had been employed previously by Scatchard[3] and Scatchard and Hamer,[4] to the correlation of ternary vapor-liquid equilibrium data for the system heptane-methanol-toluene.

The resulting correlating equation contained 12 constants, of which nine could be determined from the binary data, and three from the ternary data. The increased number of constants was believed to enable a closer fit to the experimental data by the resulting equation than could be obtained by other proposed relationships. The method, however, does not permit the prediction of multicomponent or ternary data from binary data. In general the correlating equations involve the use of the so-called virial coefficients for the pure components.

The experimental equilibrium data were smoothed and extrapolated by the use of the correlating equation and applied to plate-to-plate calculations for a tower separating toluene from normal heptane with methanol. The methods of calculation were those described in the first paper of the program presented by Dr. Benedict. The effect of the reflux ratio on the number of trays required to produce substantially pure toluene was shown by these calculations.

In "Continuous Esterification of Butanol with Acetic Acid", Dr. Leyes showed an interesting example of a rather unusual application of azeotropic distillation. In many organic reactions such as nitration or sulfination, water is given off as a product, diluting and slowing down the reaction, thereby seriously limiting the yields which may be obtained from equipment in a definite time.

This paper showed how such a reaction can be carried out in a fractionating-column type of apparatus using azeotropic distillation to remove the water as it is formed as a distillate product. The water is separated in the reflux accumulated after condensation and the organic material passing overhead with the water is returned to the column as reflux. Sulfuric acid was employed as a catalyst in this investigation and was introduced at the top of the column.

Experimental data obtained on a laboratory apparatus correlated the kinetic effect with distillation factor and showed that approximately 25% of the reaction took place in the reboiler of the column, the remainder occurring in the column itself.

The effect of contact time was studied by varying the amount of holdup on the plate over a range of about 300% and with feed range varying by about 250%. It was shown that a continuous esterification in a fractionating column can be calculated and the equipment designed, if the laws pertaining to the kinetic and distillation processes are known. The continuous reaction follows the same kinetic laws as in a static system with the effect of distillation superimposed; and by combining the kinetic data with vapor-liquid equilibrium data, the extent of conversion may be calculated by the plate-to-plate method. The vapor-liquid equilibrium data used was based on measurements in the laboratory apparatus with the kinetic effect being removed by means of previous information.

The final result indicated that previously held ideas should be modified. Long times of contact and attainment of esterification equilibrium on a given plate are not required for a high overall yield. Large plate holdups are probably not desirable since short times of contact give much higher rates. The results indicated that about six equilibrium plates would be satisfactory for a 99% yield.

### Vital Information

This meeting brought forth considerable information on the correlation and prediction of vapor-liquid equilibrium data for non-ideal complex systems, information badly needed for the design and calculation of distillation equipment handling non-ideal mixtures. The methods of calculation demonstrated in the symposium indicate that with the development of more vapor-liquid equilibrium data and plate efficiencies, it will be possible to design distillation equipment for azeotropic and extractive operations with as much precision as is now available in the calculation and design of fractionating equipment for regular mixtures.

Future symposia are now tentatively scheduled for the regional meetings of the American Institute of Chemical Engineers at Houston, Texas, in October, and in San Francisco in September.

A sustained interest in the subject was in evidence throughout the long program. Following an informal social hour and dinner, Dr. Albert B. Newman, Dean of Engineering, College of the City of New York, presented an address entitled "The Chemical Engineer as a Member of a Profession". His address dealt with some of the current problems of a professional nature now facing chemical engineers.

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THE advantages of the percolation finishing process go beyond its ability to produce lubricating oils of superior quality. This process can finish these quality oils at a low operating cost by using the adsorbent over and over again.

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# EFFECT OF SUPERCOMPRESSIBILITY Of Natural Gas on Compressor Performance

*By Robert S. Ridgway*

**Savings of as much as 15% in compressor requirements can often be accomplished in plants compressing gases to high pressures by taking into account the effect of supercompressibility, a condition which exists when gases are handled as increased pressures and temperatures of such an order that deviations from ideal gas laws occur. Under such conditions of supercompressibility, a compressor may be handling a through-put of 150 to 200% of its calculated capacity, with a horsepower requirement of the same order of magnitude.**

**This article presents a simple and easy method for the accurate computation of compressor cylinder capacities and horsepowers under conditions of supercompressibility.**

THE factors relating to the compression of gases consisting principally of methane at normal pressures have been well established and we have been able to predict the performance of compressors operating under these conditions with good accuracy. When pressures and temperatures are such that deviations from ideal gas laws exist, the effect is known as supercompressibility, and the operation of the compressor cylinder under such conditions must be thoroughly understood in order to predict the volume throughput and horsepower involved.

The effect of supercompressibility is very pronounced at high pressures and even with so called "dry" gases it may be worth recognizing at suction pressures as low as 200 lbs. With "wet" gas mixtures and those which are not principally methane, the effect is usually appreciable at low pressures. This discussion will be confined to performance at high pressures, though the methods presented are applicable to performance at any pressure if the factors are available.

When we find a cylinder handling, in some cases, a throughput of 150 to 200% of that calculated neglecting supercompressibility, with a horsepower requirement in the same order of magnitude, we have a condition which we cannot afford to overlook. There seems to be some tendency to ignore the effect of supercompressibility upon compressor performance and to assume that discrepancies from this source can be neglected. It is the aim of this paper to point out the dangers of such practice, to indicate the practical value of the proper treatment, and to present the methods of calculation which recognize this effect. Because this phenomenon is usually most pronounced at relatively high pressures, a discussion of it is very timely as repressuring and cycling operations come to the fore.

### Compressibility Factors

Excellent papers and curves on the subject of deviation of natural gas from ideal gas laws have been presented in recent years and are readily available.[1, 2] The methods of calculating compressibility factors have been adequately treated and need no review here, except, perhaps, to emphasize that the factor is a multiplier used in finding the volume occupied by a given weight of "deviated" gas from the volume occupied by the same weight of gas under ideal gas laws. Curves have been published showing compressibility, or "Z" factors for

**Robert S. Ridgeway, the author**

natural gases as a function of the pseudo-reduced pressures and temperatures. In Fig. 1 we reproduce those of Dr. G. G. Brown.[1]

For the gas being compressed it will be necessary to determine these compressibility factors at both suction and discharge conditions. Normally, for any compressor problem we know the suction and discharge pressures and the suction temperature. At once the problem arises of how to determine the correct discharge temperature under conditions of supercompressibility. This can readily be approximated from entropy-enthalpy diagram in which the deviation from perfect gas laws has been taken into account. Dr. Brown[3] has published a set of those curves covering natural gases of gravities between 0.6 and 1.0, through wide ranges of pressure and temperature. By his courtesy Figs. 2 and 3, for gravities of 0.6 and 0.7, are reproduced.

From a point corresponding to the pressure and temperature at suction conditions, follow a vertical line of constant entropy to a point showing the discharge pressure. The temperature may be read directly. This is adiabatic compression, of course, If the analysis of the gas is available, the exact pseudo-critical temperature and pressure (required for use in determining the compressibility factor from Fig. 1) can be determined by methods shown elsewhere.[1] If only the gas gravity is known, these pseudo-critical constants can be closely approximated by curves which have been prepared for this purpose by the Gas Measurement Committee of the C.N.G.A. and they are presented in Fig. 4. The pseudo-reduced pressure, $P_r$, is equal to the absolute pressure in pounds divided by the

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pseudo-critical pressure, $P_c$. The pseudo-reduced temperature, $T_r$, is equal to the absolute temperature in degrees Rankine divided by the pseudo-critical temperature, $T_c$. With this information and Fig. 1 we can readily determine the compressibility factors for both suction and discharge conditions.

It is important that we get the relation between the compressibility factors at suction and those at discharge conditions. To make this clear, the compressibility factors at several suction conditions have been plotted on the compressibility factors curve, Fig. 1, and each of these has been connected by dotted lines to the corresponding compressibility factors at discharge conditions. As an illustration, ratios of compression of 3 have been chosen, and an intake temperature of 60° F. has been selected in all cases. Gas gravities of 0.6 compression of 3 have been chosen, and an intake temperature of 60° F. has been selected in all cases. Gas gravities of 0.6 and 0.8 have been shown. In general it may be seen that the compressibility factors are lower at suction conditions than at the corresponding discharge conditions, except where the suction pressures on heavier gases are below the pseudo-critical pressure. In the few cases where the compressibility factor at suction is higher, there is not much difference between the factors.

It is interesting to note that the increase in temperature due to compression always tends to raise the compressibility factor at discharge; hence, in the left hand area of the curve, this effect tends to compensate for the drooping curves and equalize the factor at suction to that at discharge conditions. In the right hand area where the curves are rising the effect is cumulative, and wide differences between factors at suction

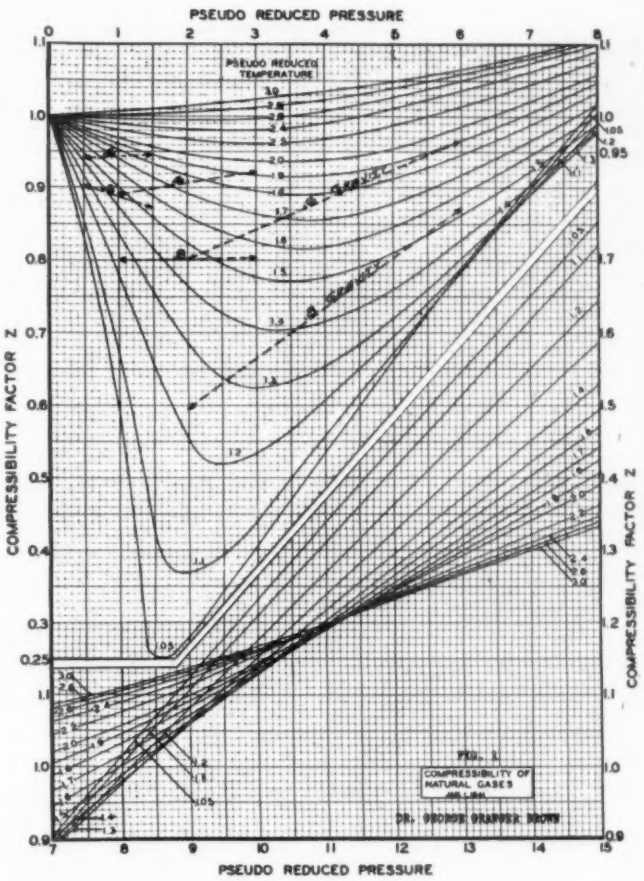
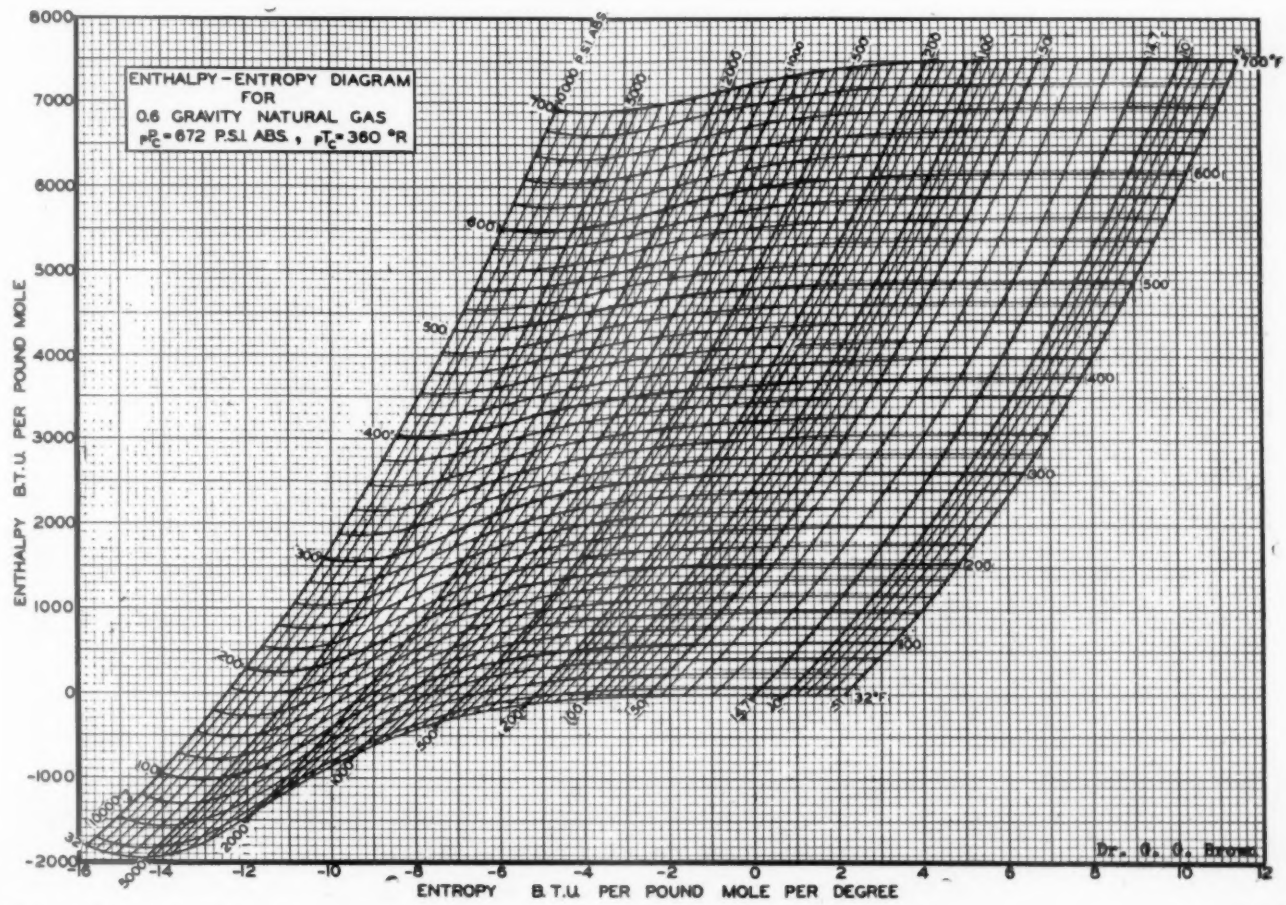



**Fig. 1—(Right)—Compressibility factor "Z" for natural gases as a function of pseudo reduced pressure**

**Fig. 2—(Below)—Enthalpy-entropy diagram for 0.6 gravity natural gas**


ENTHALPY - ENTROPY DIAGRAM
FOR
0.6 GRAVITY NATURAL GAS
$P_c$ = 672 P.S.I. ABS. , $T_c$ = 360 °R
ENTHALPY B.T.U. PER POUND MOLE
ENTROPY B.T.U. PER POUND MOLE PER DEGREE
Dr. G. G. Brown

and discharge occur, with the greatest deviation from ideal gas laws occurring at suction conditions. This characteristic is important as it relates itself to the performance of compressor cylinders at high pressures.

### Cylinder Capacity

Without doubt, the clearest method of showing the effect of supercompressibility upon the capacity of the cylinder is the conventional indicator *PV* diagram, Fig. 5. The end of the discharge stroke, 4, is a point fixed only by the construction of the cylinder and is the proper starting point for such an analysis. The clearance volume, 4-*a*, represents that which is in the cylinder head at the end of stroke of the piston. Under ideal gas laws the gas within this volume would re-expand back to point 1 according to the accepted volumetric efficiency formula

$$E_v = K - C(R^{1/n} - 1) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where the value for $K$ is theoretically 1.0, but is frequently assumed to lie between .95 and 1.0 to allow for ring and valve leakages, $C$ is the clearance in percent, $R$ is the ratio of compressions, and $n$ is the exponent for the re-expansion. If the length of stroke 8-2 is chosen as unity, then the length of the suction line 1-2 is also the volumetric efficiency.

If the gas within the cylinder at discharge conditions has deviated from ideal gas laws and the compressibility factor is less than 1.0, the clearance volume, 4-*a*, contains a greater weight of gas, or more standard cubic feet than would be contained in this volume under ideal gas laws. If this volume is re-expanded down to suction conditions, and if no deviation from the gas laws occurs at this point, then the volume occupied

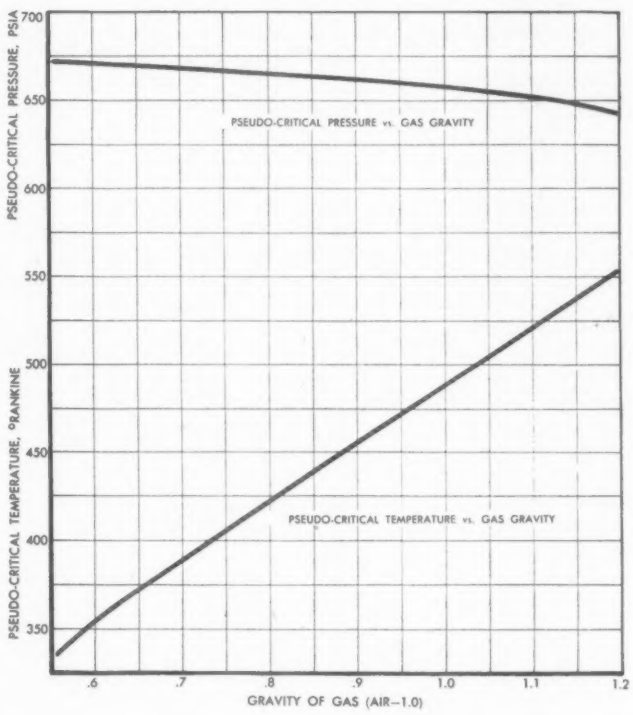



**Fig. 4—Pseudo-critical properties of hydrocarbon gases (C. N. G. A. data)**

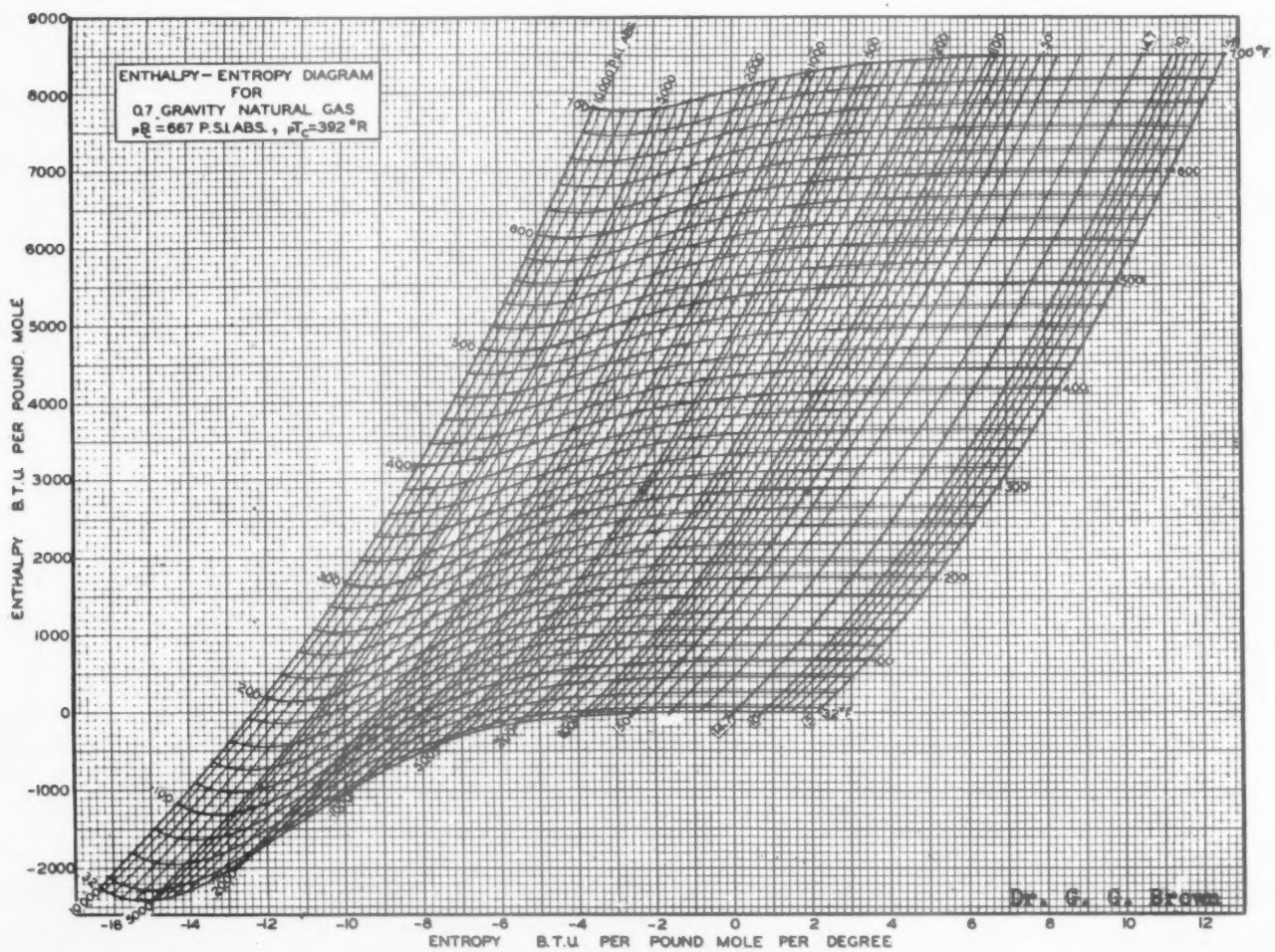
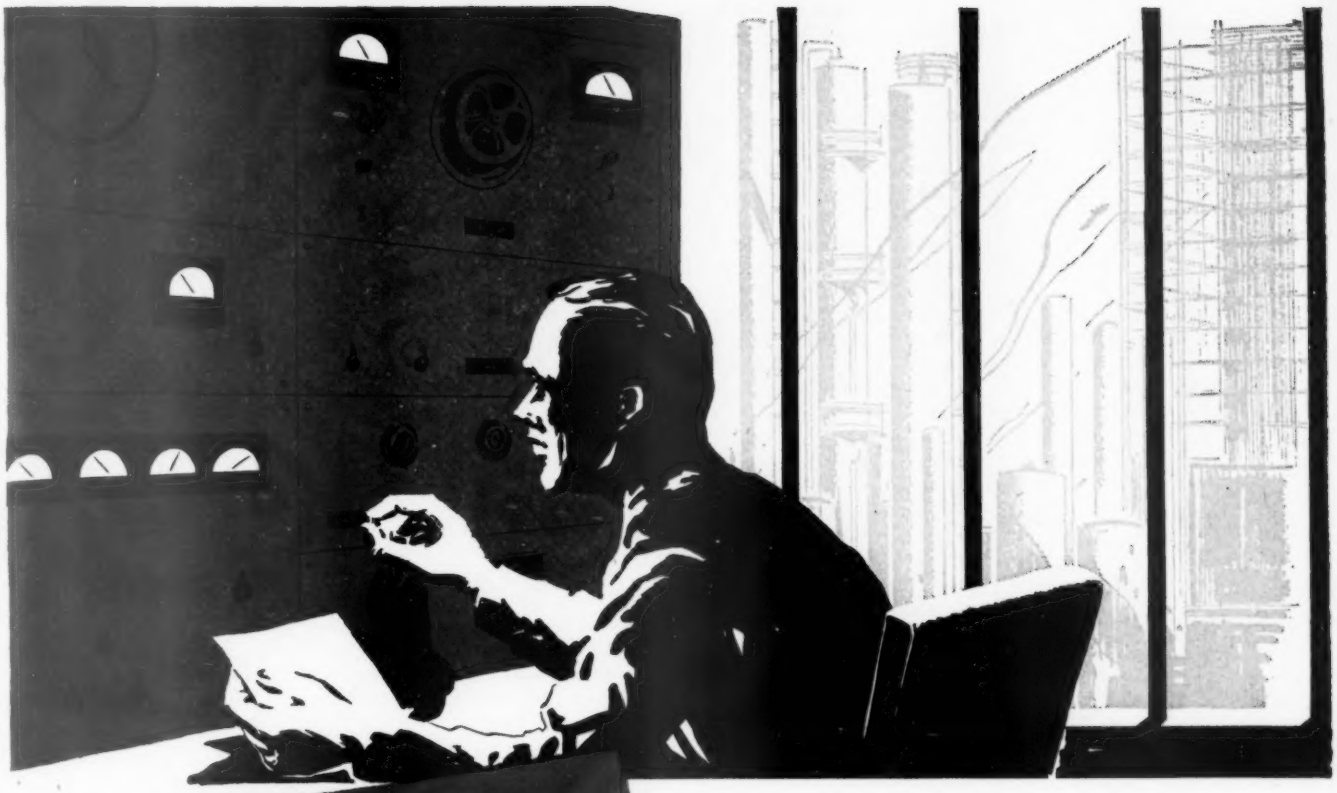



**Fig. 3—Enthalpy-entropy diagram for 0.7 gravity natural gas**



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| Plant Operations Involved | |
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| Thermal Cracking | |
| Catalytic Cracking | |
| Alkylation | |
| Catalytic Polymerization (Cumene & Codimer) | |
| Types of Samples Analyzed | |
| $C_3$ through $C_8$ (including fixed gases) | |
| $C_4$ fractions | |
| $C_5$ fractions | |
| Hexane Mixtures | |
| Heptane Mixtures | |
| Octane Mixtures | |

| | |
|---|---|
| Samples analyzed per month (avg.) | 235 |
| Instrument operating time, per month | 275 hrs. |
| Personnel time, per month | 1250 hrs. |
| Instrument shut-down time, per month (repairs, maintenance, etc.) | 20 hrs. |

**BEST MONTH OF OPERATION**

| | |
|---|---|
| No. of samples analyzed | 400 |
| Instrument operation time | 400 hrs. |
| Personnel time (operating & computing) | 1200 hrs. |

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by the clearance gas becomes $(b\text{-}1)/Z_d$, or $b$-5. The volumetric efficiency in such a case is represented by 5-2.

Under most conditions, as has been shown previously, when there is a deviation at discharge conditions the deviation is still greater at suction conditions. In any event, whenever deviation exists at all under suction conditions the volume occupied by the re-expanded clearance gas must be reduced from $b$-5 by the compressibility factor at suction. $Z_s$, which moves point 5 to point 6. (In Fig. 5 the compressibility factor at suction was smaller than that at discharge.) Thus we may say that the volumetric efficiency under conditions involving supercompressibility can be designated by $E_{vs}$ and is determined by correcting the "expanded" clearance volume at suction pressure under ideal gas law conditions by the ratio $Z_s/Z_d$. This can be written as follows:

$$1+C-E_{vs}=(1+C-E_v)\frac{Z_s}{Z_d}$$

*or*

$$E_{vs}=1+C-(1+C-E_v)\frac{Z_s}{Z_d} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where $C$ = per cent cylinder clearance.

Or we can make the proper correction to the volumetric efficiency formula, Equation 1. Expanding the formula:

$$E_v=K+C-CR^{1/n}$$

The $CR^{1/n}$ term applies to the gas which is re-expanded, therefore this term must be corrected by $Z_s/Z_d$ to permit the formula to apply under conditions of supercompressibility. Under such conditions

$$E_{vs}=K+C-CR^{1/n}\frac{Z_s}{Z_d}$$

$$=K-C\left(R^{1/n}\frac{Z_s}{Z_d}-1\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

It is obvious at this point that if the compressibility factor at suction is equal to the compressibility factor at discharge, even though they do not equal 1.0, the *shape* of the card is not changed, and $E_v=E_{vs}$.

Thus we have a method of finding the volumetric efficiency under conditions involving gases which deviate from ideal gas laws. This is essential for the next step, that of finding the *capacity* of the cylinder under these conditions.

The gas which was taken into the cylinder along the new suction line 6-2 is "deviated" in proportion to the compressibility factor $Z_s$, and therefore to find the actual volume in standard feet of gas, the volume represented by 6-2 must be divided by $Z_s$.

We can now say that:
Cylinder capacity under conditions involving supercompressibility

$$=\left[\begin{matrix}\text{capacity calculated}\\ \text{neglecting}\\ \text{supercompressibility}\end{matrix}\right]\times\left(\frac{E_{vs}}{E_v\times Z_s}\right) \quad \ldots\ldots\ldots\ldots (4)$$

$$=\left[\begin{matrix}\text{cylinder}\\ \text{dis-}\\ \text{placement}\end{matrix}\right]\times\left(\frac{E_{vs}\times\text{suct. psia}\times 520^\circ}{Z_s\times 14.7\times(460+t^\circ\text{ suct.})}\right) \quad \ldots\ldots (5)$$

This formula can be used in either form except when $E_v=0$. Equation 5 must be used in this case.

**Capacity Problem**

In order to clarify the application of the foregoing, let us solve a problem involving cylinder capacity at high pressure. A gas of 0.65 gravity and 80° F. temperature is to be compressed from 1500 psia to 4500 psia in a cylinder of 15% clearance whose displacement is 45,000 cu. ft. per day. It is required to compare the capacity of the cylinder when deviation from ideal gas laws is neglected and when it is recognized:

Neglecting deviation,

$$E_v=K-C(R^{1/n}-1)$$

Assuming the re-expansion "$n$" = 1.2, $K$ = .97, and $R$ = 4500/1500 = 3.0, then

$$E_v=.97-.15(3^{1/1.2}-1)=.745$$

Capacity in Std. Cu Ft./day

$$=\left[\begin{matrix}\text{displacement}\\ \text{in cu. ft.}\\ \text{per day}\end{matrix}\right]\times E_v\times\left(\frac{\text{suct. psia}}{14.7}\right)\times\left(\frac{520}{T^\circ\text{ suct.}}\right)$$

$$=45{,}000\times.745\times\frac{1500}{14.7}\times\frac{520}{540}$$

$$=3{,}290{,}000$$

For the computations when deviation is recognized: The compressibility factor at suction conditions is determined thus:

Pseudo-critical Pressure (from Fig. 4):

$$P_c=670 \text{ psia}$$

Pseudo-reduced Pressure:

$$P_r=\frac{P}{P_c}=\frac{1500}{670}=2.24$$

Pseudo-critical Temperature (from Fig. 4):

$$T_c=373^\circ \text{R.}$$

Pseudo-reduced Temperature:

$$T_r=\frac{T}{T_c}=\frac{540}{373}=1.45$$

Compressibility factor at suction (from Fig. 1):

$$Z_s=.78$$

Similarly, the compressibility factor for discharge conditions can be calculated:

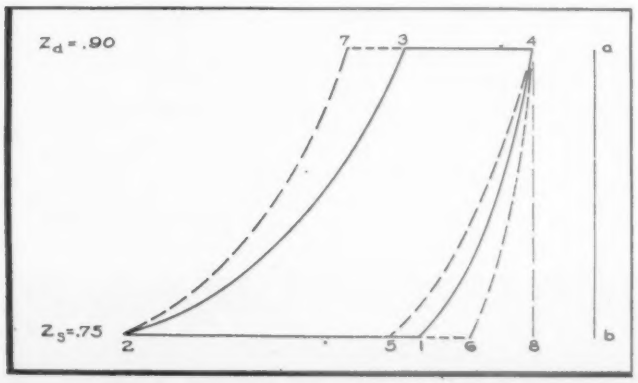
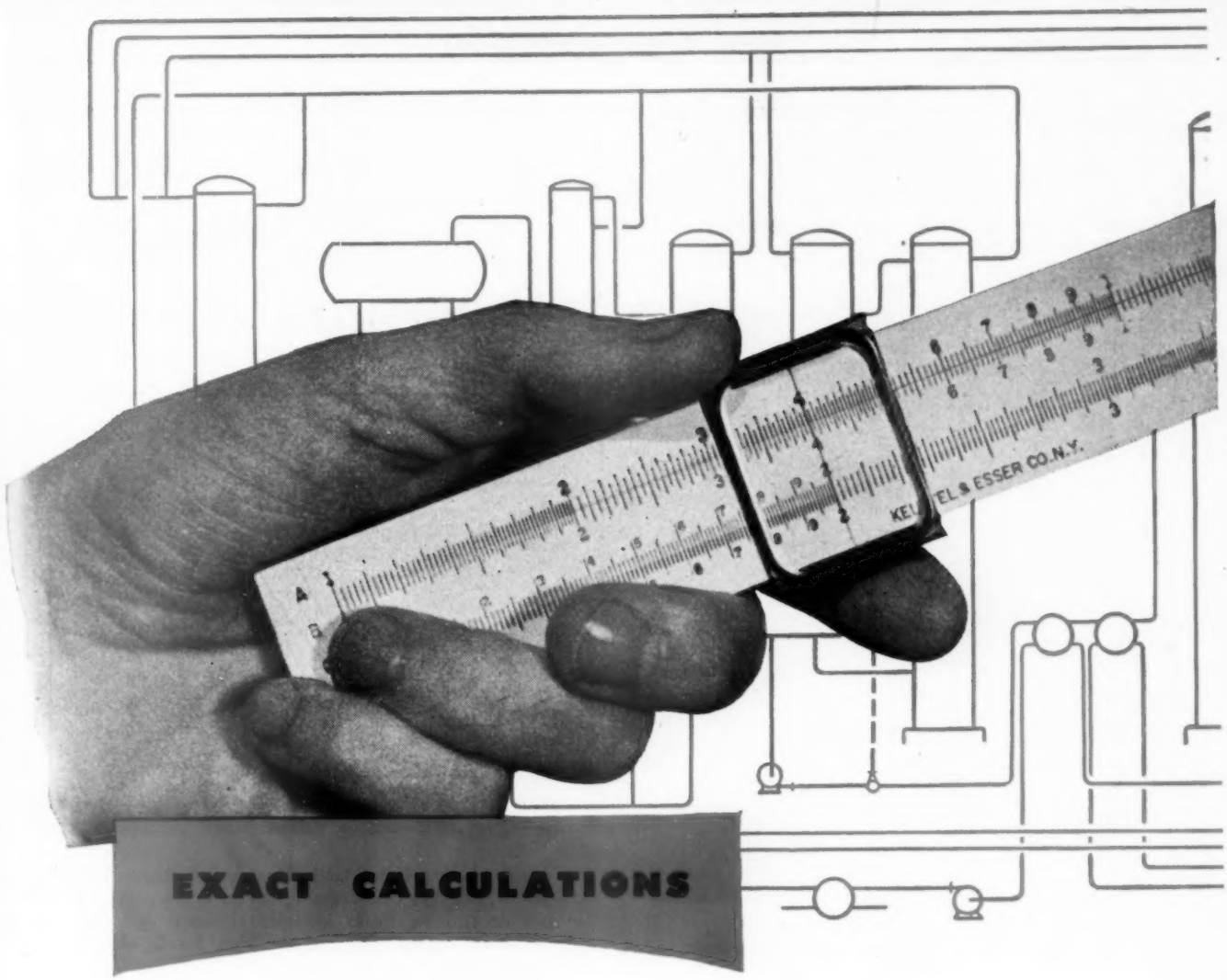



**Fig. 5—Conventional indicator PV diagram**

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From Fig. 2, rising vertically from the suction condition of 1500 psia and 80° F., to 4500 psia, the discharge temperature is seen to be 230° F. for a gas of 0.6 gravity. Similarly, from Fig. 3, the discharge temperature is seen to be 220° F. for a gas of 0.7 gravity. For the required condition of 0.65 gravity, an average temperature of 225° may be assumed.
Pseudo-reduced Pressure:

$$P_r=\frac{P}{P_c}=\frac{4500}{670}=6.72$$

Pseudo-reduced Temperature:

$$T_r=\frac{T}{T_c}=\frac{685}{373}=1.84$$

Compressibility factor at discharge (from Fig. 1):

$$Z_d=.98$$

Then, using Equations 2 and 4:

$$E_{vz}=1+C-(1+C-E_v)\frac{Z_s}{Z_d}$$

$$=1.15-(1.15-.745)\frac{.78}{.98}$$

$$=.828$$

and

Capacity

$$=\left[\begin{array}{l}\text{capacity}\\ \text{neglecting}\\ \text{deviation}\end{array}\right]\times\left(\frac{E_{vz}}{E_v\times Z_s}\right)$$

$$=3{,}290{,}000\times\frac{.828}{.745\times.78}$$

$$=4{,}690{,}000 \text{ std. cu. ft. per day}$$

Thus, due to supercompressibility, the capacity of this cylinder under these conditions has been shown to be greater by 42.5%.

### Effect of Clearance

Equations 4 and 5 being related to volumetric efficiency indicate that the correction factors obtained therefrom varv with the per cent of cylinder clearance. The reason for this is apparent from the diagrams of Fig. 6. If the clearance volume 4-a is small, then the volume b-1 is small, and so is the $Z_s/Z_d$ correction to it, 6-1. When the clearance 4-a is large, b-1 is also large and the $Z_s/Z_d$ correction to it makes 1-6 much larger and a much greater proportion of the uncorrected $E_v$, 1-2. Thus, where $Z_s$ is not equal to $Z_d$ it becomes apparent that the greater the clearance, the greater is the effect of deviation upon calculated cylinder capacity.

Normally we *increase* the cylinder clearance whenever we desire to *decrease* the cylinder capacity. In the usual case, where $Z_s$ is smaller, this unloading effect is reduced by the deviation from ideal gas laws. Indeed, one is entitled to wonder if increasing the clearance might not increase the cylinder capacity instead of decreasing it. Such is not the case, though the unloading effect due to adding clearance can be greatly offset by the application of Equation 2.

The curve of Fig. 7 is shown to illustrate this effect. As in the foregoing example, gas of 0.65 gravity and 80° F. temperature is being compressed from 1500 psia to 4500 psia.

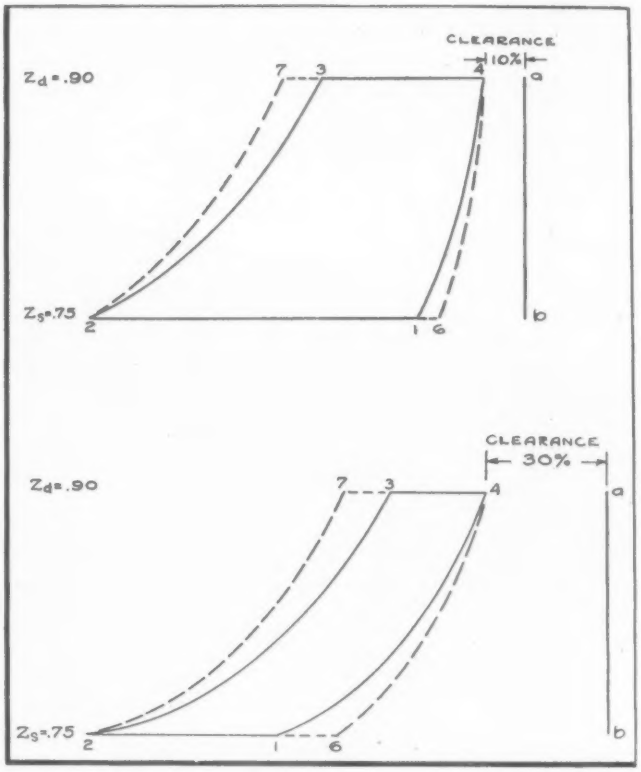


**Fig. 6—Effect of clearance volume upon cylinder capacity**

The compressibility factors at suction and discharge are noted. In curve A, cylinder clearances up to 40% are plotted against the per cent increases in cylinder capacity due to supercompressibility. This curve shows that for a clearance of 40% the cylinder can be expected to handle 201% of the volume calculated neglecting the deviation. At 0% clearance there is obviously no volumetric efficiency correction. The increase of capacity to 128% at this point is merely $1/Z_s$ or $1/.78$.

Although horsepower has not been discussed as yet, it is plotted as curve B to make the group complete and to correspond with curve A. It is obtained merely by multiplying the per cent increase in capacity as shown in curve A, by 61.6/70, which is the ratio of horsepower per million std. cu. ft. per day when recognizing supercompressibility to the horsepower factor neglecting it.

Curve C shows the decrease in cylinder capacity and horsepower with increase of clearance when no deviation occurs, using the capacity at 0% clearance as 100%. This curve merely constitutes a plot of the normal volumetric efficiency versus clearance relationship.

Similarly, curve D plots $E_{vz}$ and shows the decrease in capacity and horsepower due to adding clearance, when the capacity and horsepower at 0% clearance are taken as 100%, and the computations are corrected for the deviation from ideal gas laws according to the foregoing. The comparison of curve D with curve C shows the reduction in the unloading effect of adding clearance due to the deviation under these particular compressibility factors.

Curves E and F are plotted to show the capacity and horsepower due to supercompressibility if the capacity and horsepower of the same cylinder at 0% clearance neglecting the deviation equals 100%.

### Horsepower Requirement

The effect of supercompressibility upon the horsepower of the cylinder is clearly shown on the indicator diagram. In a manner similar to that by which we corrected the re-expansion line, we can also correct the compression line. On figure 6 where $Z_d$ is greater than $Z_s$ (greater deviation from ideal

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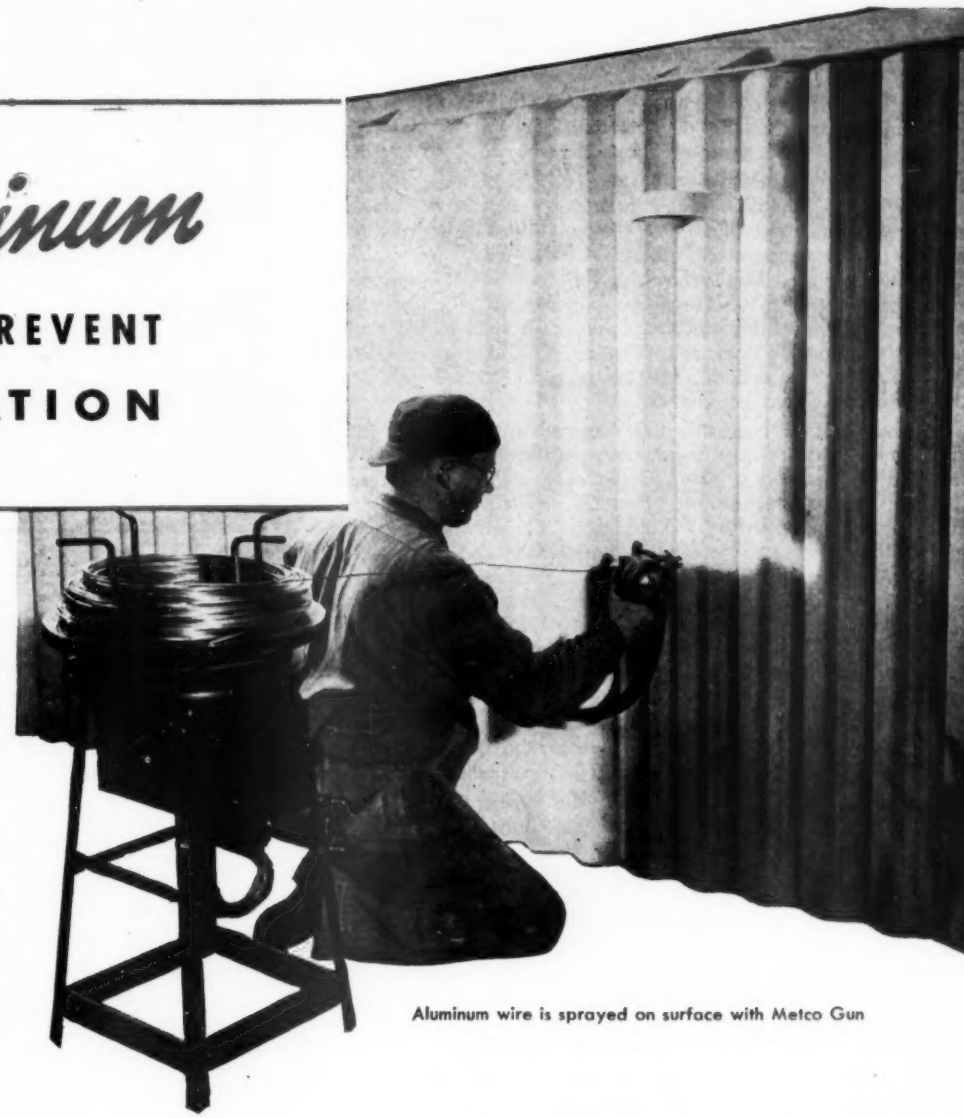

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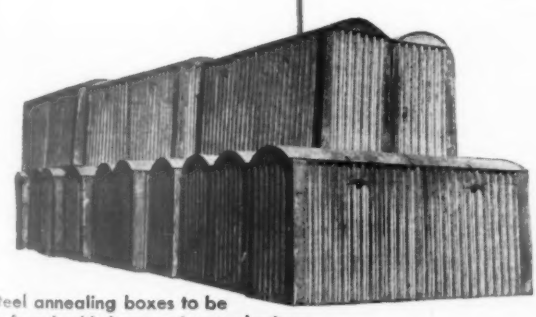

Steel annealing boxes to be surfaced with heat resistant aluminum

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gas laws at suction conditions) it is apparent that as the gas is being compressed, the deviation thereof will be reduced, and it will occupy a *greater* volume than it would have done had the deviation remained unchanged.

By applying the ratio of compressibility factors at various pressure increments to those at intake conditions and correcting for the slight temperature differences, the true compression line can be plotted. This is shown on Fig. 6 as 2-7. It is obvious what happens to the horsepower requirement of a cylinder handling gas under the conditions shown. It is increased both on the compression and re-expansion ends of the cylinder. And, of course, the cylinder with the largest clearance provides the greatest percentage increase.

A great deal of confusion has centered around this point. Under most conditions of supercompressibility the horsepower required to compress a given weight of gas will be less than for ideal gas law conditions. For any particular compressor cylinder, however, if the deviation of the gas being compressed is greater at suction, that cylinder will handle an excess of gas great enough to more than offset the reduced horsepower per pound, and for this reason the horsepower required by the cylinder will be increased beyond the requirement for gases which do not deviate from ideal gas laws. From the indicator diagram it will be apparent that the only condition for which the size of the card (and therefore the horsepower of the cylinder) will be unchanged under conditions where the gas deviates from ideal gas laws will be that where the compressibility factor is the same at discharge as it is at suction conditions.

In such a case the cylinder will handle an increased weight of gas as compared to ideal gas law conditions, due to $Z_s$ in the denominator of Equation 4. Because the horsepower for this cylinder is unchanged, then obviously the horsepower per pound is reduced. Usually, however, $Z_s$ is less than $Z_d$ and therefore we can generalize by saying that under most conditions of supercompressibility, the "horsepower per million" is decreased, but the horsepower per cylinder is increased. It is obvious that we must not confuse the two cases.

### Horsepower by Approximate Method

Since from the foregoing we can determine the capacity of any cylinder when handling gas which deviates from ideal gas laws, we have only to know how to obtain the horsepower per pound, or per million std. cu. ft. of gas under such conditions in order to determine the horsepower required for the cylinder. Several methods have been developed to provide it. The author has developed a very rapid approximate method which, in the solution of a number of problems covering a wide range of conditions, has given a maximum error of 2%. This method of determining the horsepower requirement consists of averaging the compressibility factor at suction with that at discharge and taking the average as the per cent by which the horsepower per million neglecting supercompressibility is multiplied to find the corresponding horsepower per million cu. ft. per day, measured at 14.7 psia and suction temperature when supercompressibility is considered.

Fig. 8 is shown, slightly exaggerated, to illustrate what has been done in this approximate method. The solid card a-b-c-d would exist when compressing gas without deviation from the gas laws. If the stroke on a single acting piston in the same cylinder is shortened so that the cylinder takes in the same weight of gas when it deviates from the gas laws, the card would become e-f-g-d. If we displace e-f- to a-r, card a-r-g-d defines an area almost identical to e-f-g-d. The author's method of obtaining the horsepower by averaging $Z_s$ with $Z_d$ produces the card a-x-y-d. The amount by which area A differs from area B in the per cent of the total card is the major error in this assumption. Obviously, in the case where $Z_s$ equals $Z_d$, the "*n*" values are not changed and this method is exact. In such a case the card would be a-r-s-d.

The statement was made that the greatest error found in the author's method of approximating the horsepower was 2%. What was considered to be the exact horsepower requirement was obtained by the tedious method of accurately plotting the

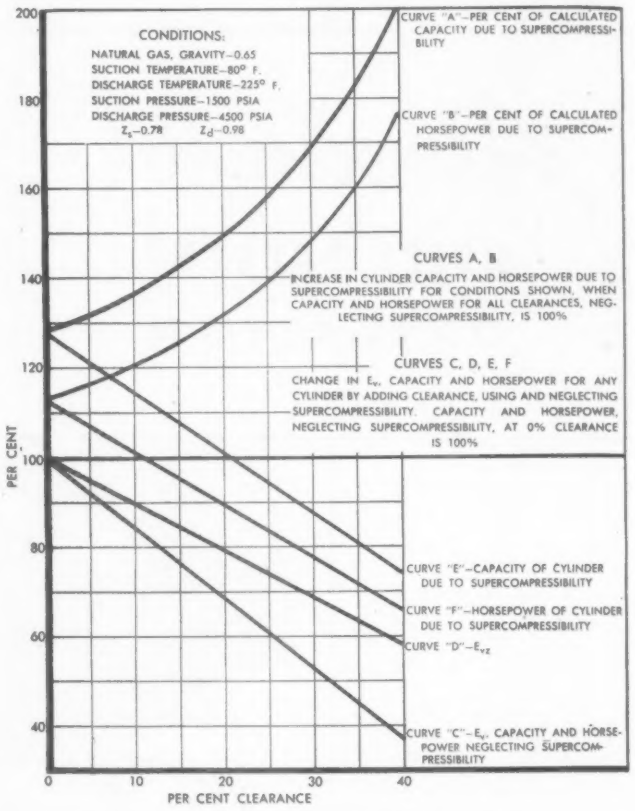

CONDITIONS:
NATURAL GAS, GRAVITY—0.65
SUCTION TEMPERATURE—80° F.
DISCHARGE TEMPERATURE—225° F.
SUCTION PRESSURE—1500 PSIA
DISCHARGE PRESSURE—4500 PSIA
$Z_s$—0.78 $Z_d$—0.98
CURVE "A"—PER CENT OF CALCULATED CAPACITY DUE TO SUPERCOMPRESSIBILITY
CURVE "B"—PER CENT OF CALCULATED HORSEPOWER DUE TO SUPERCOMPRESSIBILITY
CURVES A, B
INCREASE IN CYLINDER CAPACITY AND HORSEPOWER DUE TO SUPERCOMPRESSIBILITY FOR CONDITIONS SHOWN, WHEN CAPACITY AND HORSEPOWER FOR ALL CLEARANCES, NEGLECTING SUPERCOMPRESSIBILITY, IS 100%
CURVES C, D, E, F
CHANGE IN $E_v$, CAPACITY AND HORSEPOWER FOR ANY CYLINDER BY ADDING CLEARANCE, USING AND NEGLECTING SUPERCOMPRESSIBILITY. CAPACITY AND HORSEPOWER, NEGLECTING SUPERCOMPRESSIBILITY, AT 0% CLEARANCE IS 100%
CURVE "E"—CAPACITY OF CYLINDER DUE TO SUPERCOMPRESSIBILITY
CURVE "F"—HORSEPOWER OF CYLINDER DUE TO SUPERCOMPRESSIBILITY
CURVE "D"—$E_{vz}$
CURVE "C"—$E_v$, CAPACITY AND HORSEPOWER NEGLECTING SUPERCOMPRESSIBILITY
PER CENT
PER CENT CLEARANCE
200
180
160
140
120
100
80
60
40
0
10
20
30
40

**Fig. 7—Effect of supercompressibility upon compressor cylinder operation for conditions shown**

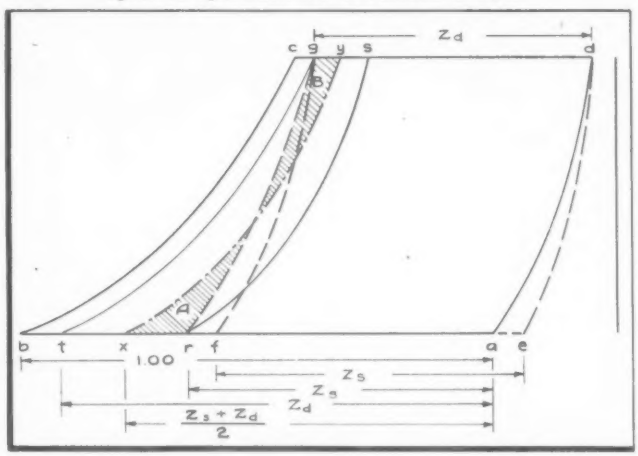



**Fig. 8—Indicator PV diagram illustrating approximate method of determining HP**

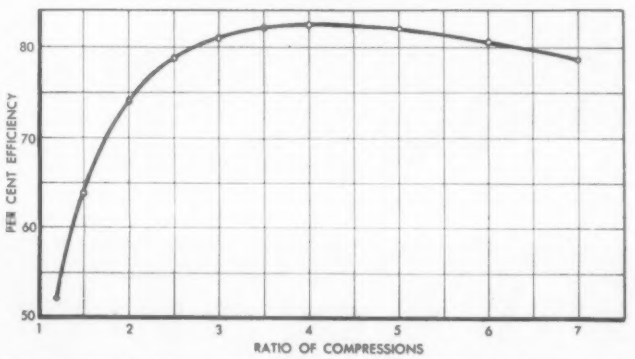
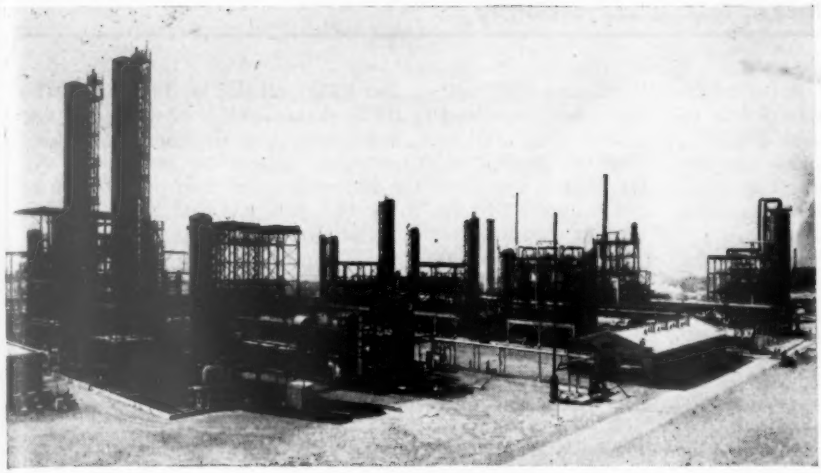
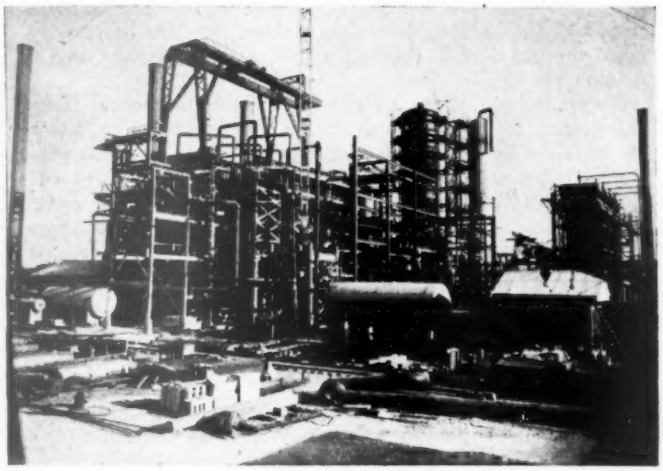
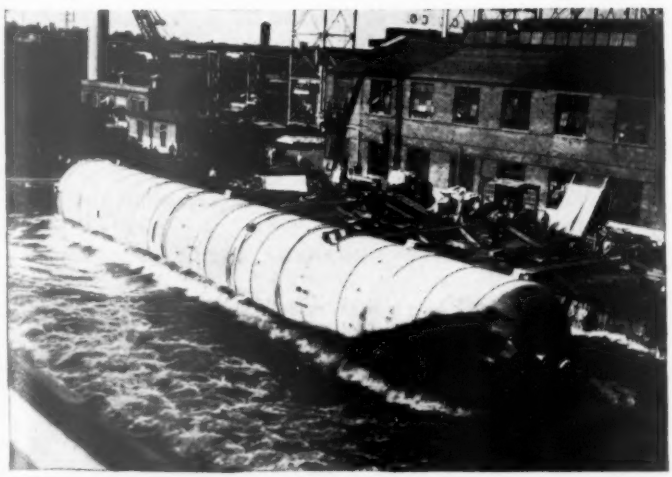



**Fig. 9—Ratio of theoretical HP to brake HP for modern angle compressor (combined compression and mechanical efficiencies)**







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normal indicator card to scale, then correcting it for supercompressibility at numerous intermediate pressure levels on the compression stroke by the ratio of $Z_p/Z_s$ and $T°_{zp}/T°_p$. For the re-expansion line correction, the clearance gas was corrected by ratio $Z_p/Z_d$ for several pressures. The areas of the normal and the supercompressibility cards were then accurately measured.

After correcting for the increased weight of gas in the cylinder when it had deviated from ideal gas laws, the horsepower per unit weight of gas was obtained for both cases. The ratio of the two was obtained and this ratio was then applied to the accepted Brake Horsepower Charts to provide the exact BHP/MMCF for compression involving supercompress.bility. This laborious method was only used to check the accuracy of the several methods of making horsepower determinations.

### Horsepower by Average "n"

Edmister[4] has suggested that the horsepower required for hydrocarbons which deviate from ideal gas laws might be closely approximated if we knew the "n" value of the compression line both at the beginning and the end of compression, and used the average of the two in the theoretical horsepower formula

$$HP=\frac{144P_1V_1}{33{,}000}\times\frac{n}{n-1}\times(R^{(n-1)/n}-1)$$

This article dealt with hydrocarbons at relatively low pressures, and the $C_p/C_v$ ratio table presented therein would not cover the range of high pressures which are the subject of this discussion. However, the method gives a fair approximation for the horsepower in the high pressure area, provided we realize that the horsepower formula above is based upon perfect gas laws, and that the $V_1$ term must be corrected by the compressibility factor at suction.

In this formula it will be recalled that to determine the horsepower per million standard feet per day it is customary to substitute 1,000,000/1,440 for $V_1$, and 14.7 for $P_1$, regardless of what the actual initial pressure and volume might be. Such a procedure is predicated upon the assumption that Boyle's law holds, and that the term $P_1V_1=k$. When Boyle's law does not hold, the product $P_1V_1$ will likely be much smaller at suction conditions than at atmospheric pressure. Hence, to make it correct for the proper suction pressure we must multiply $P_1V_1$ at atmospheric pressure by $Z_s$. In our concept of horsepower[5] we should recall the definition for work, which is the product of force times distance. If the gas deviates from Boyle's law, and the volume of gas to be compressed occupies a space smaller than Boyle's law would indicate, then the distance through which the force (piston) must act is reduced, and the work, and thus the horsepower per pound, is lessened.

The method of determining the horsepower by use of the average "*n*" is tedious but not difficult. The slope at the extreme ends of the compression line after making the supercompressibility and temperature corrections is determined by the familiar graphical solution, well described by Gill.[6] The average provides the "*n*" value needed. When someone provides us with $C_p/C_v$ ratios ("*n*" values) which will exist at suction and discharge conditions at the pressures being considered, this method of calculating the horsepower requirement will be greatly simplified. Differences up to 9% between this "average *n*" and the "exact" methods, previously described, have been noted when used in the high pressure range. Values so determined are nearly always low.

### Horsepower From Mollier Diagrams

A simple method of finding the horsepower per pound or per million std. ft. per day has been worked out for us by Dr. Brown in the entropy-enthalpy or Mollier diagrams for natural gases,[3] shown in Figs. 2 and 3. These diagrams have been developed from the chart of Fig. 1 and recognize the deviations from ideal gas laws. The enthalpy, or total heat in BTU, can be read at a point corresponding to suction conditions, and by assuming that the work of compression follows the adiabatic path of constant entropy, a vertical rise to discharge conditions will indicate the BTU enthalpy at this level. The difference, expressed in BTU, is the work done in raising one pound mole of the gas from suction to discharge conditions. This can readily be converted to horsepower per million std. cu. ft. per day from the knowledge that one pound-mole of gas occupies 379 cu. ft. at 14.7 psia and 60° F. if Z = 1.0. And at standard conditions of pressure and temperature, any "deviation" is negligible and Z can be assumed to be 1.0.

Thus, for any of the Mollier diagrams, the BTU difference shown for compressing the gas from one condition to another is the BTU required to compress 379 std. cu. ft. through this range. Knowing that 1 BTU = 778 ft.-lbs. we can determine the conversion factor from BTU to theoretical HP per million std. ft. per day by the expression

$$\text{Theoretical HP/MMSCF/dav}$$

$$=\frac{\Delta BTU\times1{,}000{,}000\times778}{379\times24\times60\times33\,000}$$

$$=\Delta BTU\times.0432$$

It must be remembered that the Mollier charts provide BTU per pound-mole, and therefore the horsepower determined therefrom will be the horsepower per million *standard* ft. per day, when the gas is at the suction temperature which was used in reading the Mollier chart.

By application of the proper factors, this theoretical horsepower can be converted to brake horsepower. The factors involved are the compression efficiency, which represent principally the compressor valve losses, and the mechanical efficiency of the compressor. These losses vary with the design of equipment, speed, ratio of compression, etc. A comparison of the theoretical horsepower required per million cu. ft. per day at 14.7 psia and suction temperature may be written as:

$$\text{Horsepower}=44.6\frac{n}{n-1}(R^{(n-1)/n}-1)\qquad(7)$$

and the charts showing brake horsepower per million for hydrocarbons as published by Worthington[8] indicate that these combined efficiencies vary with ratio of compression as shown on Fig. 9. These efficiencies can be used for the determination of brake horsepower from the theoretical horsepower obtained from the Mollier charts.

### Horsepower Problem

When applied to the same problem which was used to demonstrate the capacity calculations, we can determine the horsepower requirements by the author's method as follows: Averaging the compressibility factors,

$$\frac{Z_s+Z_d}{2}=\frac{.78+.98}{2}=.88$$

(The "exact" method as described above gave a factor 1.6% lower than this.)

BHP/MMSCF/day neglecting supercompressibility = 70.0 (from BHP charts).

BHP/MMSCF/day recognizing supercompressibility = 70 x .88 = 61.6.

The decrease due to supercompressibility is 12%.

The capacity of the cylinder was previously shown to be increased to 4,690,000 std. cu. ft. per day under conditions of supercompressibility, therefore the

$$\text{BHP for the cylinder}=4.69\times61.6$$
$$=289$$

If supercompressibility were neglected, the load on this cylinder would be calculated to be 3.290 x 70.0 = 230 BHP.

The load increase due to the deviation from ideal gas laws is obviously

$$\frac{289-230}{230}=25.6\%$$

The problem is a typical one. The capacity of the cylinder has been increased 42.5%. The brake horsepower per million per day has been reduced 12% by the effect of the deviation, but this gain in unit horsepower has been more than offset by the increase in cylinder capacity, resulting in an increase in cylinder horsepower of 25.6%. Curve B of Fig. 7 shows the percentage increase in horsepower due to supercompressibility for cylinders of various clearances, operating under the same conditions that were used for this problem. Certainly the wide differences caused by this phenomenon are of such an order of magnitude that they cannot be ignored. The conditions of gravity, temperature and compression ratio are probably quite similar to those found in cycling plants, hence the curves shown could be typical of actual field conditions.

One is entitled to ask at this point why, if supercompressibility is sometimes ignored when computing compressor cylinder sizes or determining capacity and horsepower, more trouble has not been encountered on such jobs? In the first place, it is problematical as to whether or not this practice of neglecting supercompressibility is really "widespread". High pressure installations are increasing, but their number is still relatively small, and what trouble has been caused from this source is rather hard to learn. If an operator handles more gas than he expects, he doesn't usually regard it as trouble. If his high pressure cylinder is greatly overloaded, it is usually only one of several cylinders on a single compressor, and the other cylinders often work on other services so that the overload is only on one cylinder out of the group. If a gas and load excess occurs on a unit carrying only high pressure cylinders, removal of a valve or addition of extra clearance usually remedies the situation so easily that it is not considered a problem.

The modern gas engine-driven compressor is so "overpowered" that it will take large overloads without much disturbance. Frequently the gas in a repressuring or cycling plant is two-staged, with cylinders of both stages on each compressor. In such cases the low pressure cylinder is usually not greatly affected by supercompressibility. The high pressure cylinder probably is. But the volume handled by each compressor unit is fixed by the capacity of the low pressure cylinder, therefore the excess capacity of the high pressure cylinder due to gas law deviation only serves to lower the intermediate pressure, and therefore no appreciable increase in capacity for the unit is obtained. Because the intermediate pressure is reduced, the load is reduced on both the low and the high pressure cylinders.

Even though the discrepancies described above may not, in some cases, be too hard to rectify, there is little excuse for us to make them. With the methods so easy to use we should size the cylinders to handle the correct throughput and be able to predict the correct horsepower requirement when gases deviate from ideal gas laws.

Above all, we should not fail to take advantage of the marked reduction in the horsepower requirement for compression due to supercompressibility. In the high pressure regions, reductions of 15% are common. Cycling plants frequently process huge volumes to high pressures and require large compressor installations. A reduction of 15% in horsepower in such cases represents no small saving in money. In a recent cycling plant installation, taking advantage of the reduction in horsepower due to supercompressibility meant the elimination of one compressor unit which, including installation costs, represented a saving that ran into six figures.

The methods which have been presented above will permit computations for compressor cylinder capacity and horsepower under conditions of supercompressibility to be made with good accuracy. They are simple and easy to use. It is hoped that the illustrations regarding the magnitude of the errors involved by neglecting the deviation from ideal gas laws in regions where it should be considered, and the savings which may be made by recognizing this effect, have been sufficiently convincing to encourage common use of these methods.

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(5) See "Air and Gas Compression", T. T. Gill, (Wiley) p. 18.
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# Army's 'Welder-Jeep' May Assist in Refinery Maintenance

IF A jeep can get there, so can a welder. And the result is that the versatile jeep may lend the refinery maintenance department a helping hand in the postwar future and permit it to keep isolated storage tanks and other equipment in repair with a minimum of trouble.

Consisting of a standard Army jeep with a modified arc welder bolted to the floor in place of the right-front seat, the welder-jeep has seen plenty of action in the front lines in Europe and along jungle paths in the Pacific. Light in weight, compact, highly mobile and extremely maneuverable, it can go places where heavier maintenance vehicles find the trails impassable.

Driven by a V-belt on a power take-off from the jeep's engine, it is ready for operation as soon as the vehicle is stopped. The governor, easily disengaged by a hand-operated clutch to permit normal operation of the jeep, maintains proper engine speed. Any welding current from 40 to 250 amp. is obtainable, and electrodes up to and including ¼ in. diam. are accommodated.

**Welding broken tank tread on the battlefield with the Army's welder-jeep**

# INDUSTRIAL LUBRICATION

By W. G. Forbes

## 3—Bearing Lubrication

*Q—Grooves are often cut in the pressure area of bearings with the idea of distributing the oil. Why is this idea erroneous and detrimental?*

A—Grooves should not be cut in the pressure area of bearings because such grooves not only fail to serve any useful purpose, but are highly detrimental. When grooves are cut in the pressure area of a bearing they simply allow the oil under pressure to escape, and the oil film must struggle to maintain itself under adverse conditions.

But the trouble does not end here. These grooves reduce the load carrying area, and if enough crisscross patterns are cut in this area the oil film is not only syphoned away and disrupted but the bearing becomes more vulnerable to wear as a result of the high unit pressures which must be carried on the area that remains.

Furthermore, when grooves have been cut in the pressure area of babbitt metal bearings there is a tendency for overlapping slivers to form along the edge of these grooves and as the bearings wear down, these pieces break off. It is not uncommon to find them packed into the worn down grooves and it is not uncommon for these broken off pieces to enter the pressure area and cause overheating and damage.

*Q—Where and when should oil grooves be cut in bearings?*

A—The correct place to cut an oil groove is along the top half of the bearing, in the non-pressure, or clearance, area. This groove becomes an oil reservoir to distribute the oil along the top half of the bearing, from whence it is picked up and driven into the pressure area by the revolving shaft. This groove should extend along the bearing to about ½ in. from each end.

Other variations of this method for distributing the oil are of course possible, such as cutting two forked grooves from the oil hole so as to spread the oil over the top of the journal, but such grooves should not extend into the load carrying area and should only be employed in small bearings.

For slowly rotating journals operating under heavy pressures an additional groove may be cut along the surface of the lower half of the bearing, *but above the pressure area.* This groove acts as an auxiliary oil reservoir just ahead of the pressure area and is sometimes beneficial in bearings which support heavy loads and slowly rotating shafts.

*Q—What is the average thickness of an oil film in the pressure area of a bearing?*

A—Assuming the oil supply to be constant, the average thickness of an oil film is about 1/1000 in. This means actual fluid clearance between the highest irregularities occurring on the contact surfaces. The amount may seem astonishingly small but nevertheless it is easily maintained between journals and bearings, between piston rings and cylinder walls, between meshing gear teeth, and so on indefinitely, and as long as this fluid clearance is maintained there can be no metal to metal contact.

In many operations the oil film in the load area may fall below 1/1000 in., but as long as it doesn't break it can fall to a millionth of an inch between the highest irregularities and still there can be no metal to metal contact.

*Q—What maximum unit pressures are carried in the projected load area of (a) turbine shaft bearings and (b) crankpin bearings on internal combustion engines?*

A—(a) The average unit pressure in the projected load area of a turbine bearing will vary from about 50 psi to a maximum of about 150 psi for the largest turbines.

(b) The crankpin bearings in high speed internal combustion engines may carry unit loads up to 3000 psi. These pressures are exceptional, but they do occur on large aircraft engines during the take-off period, and during the first few minutes of full throttle operation when maximum power is employed to gain altitude. Pressures of this magnitude just about reach the limit of oil film formation. The maximum unit pressure is generally not more than about 1500 psi on the crankpin bearings of high speed internal combustion engines. Slow speed engines carry much lower unit pressures.

*Q—Why are white mineral oils sometimes employed to lubricate bath oiled spindles operating at high speed?*

A—When a high speed spindle is designed with very little clearance to eliminate wabbling tendencies it becomes necessary to use a very light oil in order that the flow into the pressure area may proceed without interruption.

If the oil is too heavy in body it cannot easily follow the spindle, and the consequent oil drag produces excessive fluid friction which heats up the bearing until the oil reaches a temperature that makes it thinner and better able to follow the spindle. This action is sometimes objectionable and may occur with the lightest spindle oils because they may contain too much of that mysterious property known as "lubricity" or "oiliness."

The refining methods employed to make oils white in color are sufficiently drastic to remove much of their oiliness, and as a result of this reduction, white oils are sometimes better able to follow the rotating spindle with a minimum of oil drag. Hence they are sometimes more successful in reducing the operating temperature of high speed spindles.

*Q—What is the maximum pressure that an oil film can support in a plain sleeve type bearing?*

A—Tests on miniature bearings using straight mineral oils do not correlate accurately on this question because there are many variables such as type of bearing metal, surface roughness, viscosity of the oil, speed of rotation, and so on, but the average may be taken as 4000 to 7000 psi. This estimate is based on the assumption that operating conditions are ideal for the maintenance of an oil film up to the point where failure occurs.

*Q—What is the maximum pressure that an oil film can support in a Michel or Kingsbury type bearing?*

A—Oil film lubrication is produced by a fluid wedge which supports rotating or moving surfaces and maintains them in a floating position as long as the oil supply is continuous and as long as the members are free to conform to the position dictated by the wedge.

When a journal revolves in a bearing this wedge is driven into the contact area by the revolving shaft and the shaft proceeds to take up a slightly eccentric position as a result of this action. However, the Michel and Kingsbury type bearings are composed of small pads which are free to rock on pivots. Hence they tilt slightly and adjust themselves to the angle of the hydraulic wedge that is driven in between by the rotating shaft or collar. The result is a perfect oil wedge and pressures may reach four to six tons to the square inch before the oil film will break and allow metal to metal contact. In fact, so perfect are these bearings in conforming with the theory of fluid film lubrication that the babbitt metal on the face of the pads will generally crush and distort before lubrication fails.

*Q—What viscosity is generally considered a minimum for oil film lubrication?*

A—A Saybolt viscosity of about 50 sec. is generally considered a minimum viscosity for safe lubrication. Only high speeds and light loads will maintain an oil film at lower viscosities.

*Mr. Forbes is a lubricating engineer with Tide Water Associated Oil Co., New York*

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R-557

# Keeping Up With the News

*By N.P.N. Special Writer*

**This series consists of brief, technical-economic digests of selected current happenings in scientific and industrial circles which may relate to the future of the petroleum industry.**

**Among the topics upon which the spotlight of attention has been focused in recent weeks are jet propulsion fuels, pest control, quenching oils, acrylonitrile and thermal cracking.**

**The author of this series is a chemical engineer in the research subsidiary of one of the larger oil companies. His duties include a continuous survey of the current technical and economic journals in the many fields now related to the petroleum industry.**

## Jet Propulsion Fuels

The petroleum industry continues to play an active part in this "new" and challenging field. Developments have come so rapidly, however, and the need for military secrecy has been (and is still) so great, that only those concerned with the actual research are in any position to evaluate their significance.

For this reason, a recent statement issued by an executive of the Richfield Oil Corp. is of considerable interest. According to this release, the criteria for jet plane fuels are:

(1) ability to supply a maximum number of heat units per pound, in order to extend flight range; (2) a very low freezing point, so that the fuel system will function at the low temperatures prevailing in the extremely high altitudes attainable by this new type of propulsion; (3) clean burning characteristics, so that no deposits are left in the delicately balanced turbine rotor and no smoke trail is left behind the plane; and (4) a high ignition temperature, as a safety factor. According to one authority, the fuel should be an uncracked distillate.

In regard to the first criterion, another source has pointed out that a somewhat converse situation may exist—one in which the volume of the fuel load is the dominant factor, rather than the weight. Where weight considerations are dominant, a fuel approaching gasoline in properties would be indicated, whereas otherwise "heavier" fractions would seem more desirable.

All of these more or less rigid specifications make the jet fuel problem appear much more complicated than many of the early releases on jet propulsion would indicate, and such of course is the case. Each requirement eliminates otherwise usable hydrocarbons, and the Richfield executive has actually expressed the belief that, per barrel of crude oil, more gallons of 100-octane gasoline than of jet fuel can be manufactured. All predictable requirements for jet fuels should be met, however, through development of methods of close fractionation and subsequent chemical treatment.

It appears that at least four oil companies are supplying or will soon supply jet fuels, for the OPA revealed in December that it expected to establish maximum prices for such fuels for four unnamed oil companies. The Texas Co. and the Richfield Oil Corp. are among these, and Shell Oil Co., Inc., might also be included, since it has recently received considerable publicity on its new jet-fuel test laboratory. The Standard Oil Development Co. has also revealed that it has been conducting research in this field.

Just what quantities of jet propulsion fuels will be required are of course indeterminate at present. So are many questions regarding necessary properties and methods of providing fuels that possess them. Petroleum companies are continually faced with the need for research as unforeseen problem after problem arises; jet propulsion fuels seem likely to provide a good many of these soon.

## Pest Control

Petroleum companies have for many years been interested in the many types of insecticides needed for pest control and in the methods of effectively applying those developed. For this reason, a recent patent(1) is of some interest.

Claim 3 is perhaps typical of the inventive concept patented: "that method of controlling insects having a water-dwelling life phase comprising applying to and within the water bodies wherein they may develop an oleaginous composition characterized by the presence of a substantial proportion of a hydrocarbon oil of highly cyclic nature having a specific gravity of at least 1.0 based on water."

What is really new in this method, according to the specifications, is the use of an oil heavier than water. "The most generally used method of control for such pests (mosquitoes, etc.) has been the coating of the surface of stagnant water bodies with oil films leading to the killing of the insect while in the larval stage—

"While the above known mosquito control method is quite sound, it is effective only when a permanent and continuous oil film is maintained on the surface of water bodies. However, the currents, and especially the slightest winds, tend to drive the oil to the edges of the water body and around the stems of emerging plants and the like. Thus the oil soon becomes entirely unavailable for its intended purpose."

The oils proposed for the method described by the patent, however, are distributed "below the surface and upon the bottom in films or globules or otherwise." Oils of a certain viscosity (as well as specific gravity) are thus required; these may be "applied either as a spray of oil, or in the form of an emulsion or dispersion, or as an oil containing an emulsifier which becomes active upon contact with water."

Aromatic hydrocarbons are desired because they "possess the highest toxicity to insects among all other known hydrocarbons." Additional toxic materials, such as cresylic acids, may be added to the oil if desired.

According to the specifications of the patent, the following range of properties are desirable for oils for bottom application in water bodies:

| | |
|---|---|
| Gravity, °A.P.I. | Below 10 |
| Viscosity @ 100°F., Say. Univ. Secs. | From 30-400 |
| Pour Point, °F. | Below 50 |
| Viscosity-gravity-constant | 0.870 minimum |

"Actual experiments conducted in a laboratory specializing in mosquito control have shown its (an oil of this type's) high toxic effect to several species of mosquito larvae. When additional larvae were placed in the test pool several days after the application of the oil, they were killed as quickly as on the first day of application. This should be expected because the toxic components of the oil are not chemically reactive with

(1) U.S. 2,370,881, March 6, 1945, Theodore G. Roehner (to Socony-Vacuum Oil Co. Inc.), "Method of Pest Control."

the bottom slime in the pools and therefore the effectiveness of the oil does not decrease with time. Microscopic examination disclosed that oil was present in digestive systems."

Pest control, especially in tropical and subtropical climates, is still an important problem, as the Pacific war attests. The patent quoted is at least an interesting contribution.

## Quenching Oils

Quenching oils are much in use in the war effort, with its enormous output of metal equipment which must meet exacting specifications and yet be produced at high speeds. Several companies have devoted years of research attention to the development of high-speed quenching oils, and this research has yielded products of increasingly high quality and utility.

For this reason, there was considerable surprise a year or two ago when a paper was presented(2) which stated that "it is the opinion of the writers that too much consideration need not be given to high sounding sales talk. Actually, *similar results can be expected from most of the oils now used* for the purpose. As have been pointed out, *differences in capacity to quench are negligible* with proper handling."

The paper went on further to say, in its abstract, that the conclusions from the data presented indicate: "(A) there are negligible differences in the quenching rates of new and used oils. (B) There is an optimum oil temperature to produce the maximum cooling rates at the nose of the 'S-curve.' Oil temperatures above or below this optimum temperature retard the cooling rate in this important temperature range. Warm oil has the desirable effect of giving slower cooling rates in the region of the martensitic transformation. (C) Similar quenching rates are exhibited by oils of mineral and animal origin. (D) The slight differences in the quenching rates of 'light' and 'heavy' oils can be compensated for by adjusting the oil temperature. (E) The greatest variation in quenching rates developed by the oils tested is but a minor factor in terms of steel hardenability.

"Since it has been shown that *all oils are metallurgically equal* the selection of a quenching oil should be primarily controlled by the consideration of two factors: (A) a "flash and fire point" sufficiently high to prevent undue damage from fires and (B) the cost per pound of steel quenched under normal operating conditions."

Many metallurgists, both in the field of metallurgy and employed by petroleum companies, at once challenged several of these conclusions. In the written discussion which accompanies the published paper, for example, H. Gershinowitz and G. H. Waters of Shell Oil Co., Inc., stated that "we are surprised by—their conclusion that all quenching oils are metallurgically equal," although such a conclusion would not be "unattractive, for it would free us, as producers of oil, from the necessity of probing the science of metals." Other metallurgists challenged various of the other technical conclusions.

Among the more detailed "written discussions" was one by B. B. Wescott, chief metallurgist, and L. W. Vollmer, section chief, Materials Section, Gulf Research & Development Co. After sharply challenging many of the conclusions, these metallurgists pointed to what they believed to be the contributing error in the experiments performed: the use of a mirror galvanometer with a period of 1.5-2 seconds or more, stating that "it is believed that the authors' temperature recording apparatus is not sufficiently responsive to indicate accurately the changes in cooling in a specimen of the size used. A sluggish galvanometer will fail to indicate true peak rates of cooling and therefore will not develop real differences in quenching rates of the oils tested." Numerous substantiative references were quoted.

It seems, however, that once a paper is written, its data are accepted as gospel, to the contrary notwithstanding, and may be quoted by anyone seeking to prove a point for one reason or another. Thus this paper(2) has been widely quoted by those who deny that progress has been made in the manufacture of quenching oils. One of these quotations,(3) however, has been of the type which evidently has necessitated further refutation because, according to Wescott and Vollmer,(4) this particular author's "publications perpetuate data and conclusions that are invalid, and present views that we are sure are not in accord with established facts and practices."

Wescott and Vollmer point out again that "the cooling curve apparatus used by Spring and his associates was inadequate—a fact that would have become evident if they had attempted to confirm their conclusions by simple hardening tests." They go on to present considerable technical data (in one case using an oil tested by Spring et al) to demonstrate the actual differences between various oils which are evident when using suitable evaluation methods.

Quenching oils are among the many specialties which petroleum companies supply to the various industries of the nation. These companies, through intense competition, have ever continued to improve the quality of such products, and industrial acceptance of the better specialties has lent point to advertising claims.

It is therefore something of a shock to be told that years of research and the data gathered through field experience are all wrong and then to have this statement repeated by others, despite detailed refutation. Much remains to be learned concerning quenching oils—that is certain—but it is equally certain that the special quenching oils now supplied by several companies are of considerable merit and are definitely superior to the many-purpose oils not compounded especially for this application.

## Acrylonitrile

Acrylonitrile, also known variously as acrylic nitrile, vinylnitrile, propenenitrile, etc., is a substance which has left the laboratory and gone into commercial use only during the last decade. Considerable quantities—probably some 10,000,000 pounds per year, or more—are currently being used in the manufacture of the Buna-N type of oil-resistant synthetic rubber (Perbunan, Hycar-O.R., etc.), but other large-scale commercial uses, if any, have not been revealed.

This substance has for some time been receiving considerable attention in petroleum refining circles. To begin with, its present use in the Buna-N elastomers is of two-fold interest: (1) Standard Oil of New Jersey introduced such rubbers to the American scene and is still probably the leading domestic producer, and (2) there are several ways in which acrylonitrile can be synthesized from petroleum hydrocarbons.

These methods include: (1) catalytic oxidation of ethylene to ethylene oxide, followed by reaction with hydrogen cyanide to yield ethylene cyanohydrin, then dehydration to acrylonitrile; (2) reaction of ethylene with hypochlorous acid to yield ethylene chlorohydrin, which is further reacted with sodium cyanide to yield ethylene cyanohydrin, then dehydrated as mentioned above; and (3) the reaction of acetylene with hydrogen cyanide.

The last method is probably finding much commercial use, although it is questionable if much of the acetylene is coming from petroleum sources. The other two methods are also in use or have been used in the past.

A recent patent on acrylonitrile

(2) Spring, E. K., Lansdale, P. T., and Alexander, C. W., *Transactions of the American Society for Metals* 33, 42 (1944), "An Evaluation of Quenching Oils."

(3) "Metallurgicus," *Metal Progress* 46, 1273 (1944), "Bits and Pieces."

(4) Wescott, B. B. and Vollmer, L. W., *Metal Progress* 47, 935 (1945), "Quenching Oils."

synthesis[5], issued to a petroleum company, is of interest for several reasons. In Claim 4, which is representative, the patentee avers:

"The process for the production of acrylonitrile which comprises admixing methane with ammonia in a gas volume ratio within the range of five to 10 volumes of methane per volume of ammonia, subjecting said mixture to pyrolysis at a temperature within the range of 1300 to 1500°C. and at a pressure within the range of 100 to 200 mm. of mercury for a period of time within the range of 0.05 to 0.10 seconds effecting formation of hydrogen cyanide and acetylene, cooling the total effluent of said pyrolysis to a temperature within the range of 400 to 500°C., and passing the total effluent at said temperature directly into contact with a sodium cyanide catalyst at substantially atmospheric pressure for a period of time within the range of 0.5 to 2 seconds effecting conversion of hydrogen cyanide and acetylene in said effluent to acrylonitrile."

Several advantages for this process are given in the specifications. It is continuous; the presence of inert diluents in the second step are said to retard polymerization, thus raising ultimate yields of acrylonitrile; storage and handling of poisonous hydrogen cyanide and explosive acetylene are eliminated because these intermediates are used as formed; etc.

According to the specifications, the first part of the reaction may be carried out in any conventional manner; a "major portion of the heat required in the catalyst chamber (second step) is supplied by the gases themselves (which have previously been cooled to the reaction temperature), and preheating of the feed to the catalyst chambers is not required."

The patent appears to be what is known as a combination patent; that is, one which combines the elements of known reactions into a process which also must include inventive concepts; i.e., to be more than a mere addition of reactions. The production of hydrogen cyanide from methane and ammonia is a process which has been patented by at least one company (du Pont), and the pyrolysis of light hydrocarbons to yield acetylene is also comparatively well known[6].

Simultaneous production, however, has probably not been patented before, nor, presumably, has the immediate use of the effluent gases for the synthesis of acrylonitrile, although the reaction between acetylene and hydrogen cyanide is a commercial process, as previously mentioned.

Phillips is not alone in its interest in acrylonitrile manufacture, although it certainly has a definite reason for that interest: it is associated with Goodrich in the Hycar Chemical Co., manufacturers of the Hycar-O.R.'s. Another petroleum company, the Sinclair Refining Co., has actually entered the manufacturing field on at least a small scale, distributing the output of its "research laboratories" through the Harshaw Chemical Co.

A recent brochure issued by the latter company describes some 20 reactions of acrylonitrile, taken from the technical literature. The commercial significance of most of the products formed is not at once clear, but some may be of future importance.

Sinclair is also marketing, through Harshaw, other lower aliphatic nitriles —acetonitrile, propionitrile, and *n*-butyronitrile. These and acrylonitrile are suggested (through numerous listed reactions) for use in "pharmaceuticals, dye intermediates, insecticides, solvents, lacquers, rubber and plastics."

Acrylonitrile will probably remain in heavy demand after the war, since the Buna-N synthetic rubbers, because of their special properties, will probably continue or even increase in use. Additional uses will likewise be developed, although few of these promise to be on a comparable scale to use in the Buna-N's. Continued attention from petroleum companies seems likely; acrylonitrile is another in the ever-lengthening list of "chemicals from petroleum."

## Thermal Cracking

The wartime advent of catalytic cracking on a gigantic scale—over 1,000,000 barrels of charging capacity per day—has brought many refiners sharply to attention—especially those whose plants did not share in the wartime boom for one reason or another (size, nonstrategic location, transportation difficulties, etc.). In particular, it has caused many of these refiners to fear that their more fortunate competitors, equipped as they are with the latest in equipment, may raise the octane levels of postwar gasoline to values which they cannot meet without ruinous expense or a loss in markets as they frantically equip their refineries with new units.

The worst of these fears will probably not be realized, of course. In addition, many of these "underequipped" refiners "are already proceeding to turn this handicap into an advantage by immediately laying their plans for the installation of modern facilities designed for the most economical manufacture of postwar products ° ° ° immediately upon availability of materials and labor for refinery construction work, they will be ready to place orders for equipment."[7]

The article mentioned is of interest for more reasons than the above-quoted opinion and the list of reasons supporting it. For among the other technical conclusions which may be drawn from the two general studies of refinery balances which are included is the unmistakable fact that thermal cracking facilities still fit into the modern refinery, along with catalytic cracking units. This, of course, has never been doubted in technical circles, but the glamor surrounding catalytic cracking has often obscured it from general view.

The above-mentioned refinery balances also reemphasize the value of a process akin to thermal cracking—the polyforming of heavy naphthas. As the article states elsewhere, "catalytic cracking and naphtha polyforming operations are both characterized by large spreads between motor method and research octane values and will be valuable tools in meeting high research octane requirements."

In the examples cited, "the charge to the polyform unit also includes 90% of the excess butane-butylenes from the thermal and catalytic cracking operations and 60% of the propane-propylene production from these operations. In this manner the plant is maintained in vapor pressure balance, and conveniently recoverable propane-propylene is processed."

The ability of the polyform units thus to consume advantageously the excess gases produced by the catalytic cracking units makes them a valuable adjunct to such units; in addition, the octane levels of the gasolines produced, and their lead susceptibilities, make polyforming appear most attractive.

Thermal cracking, therefore, does not appear to have been "done to death" by the growth of catalytic cracking, which itself is of course only a variation of the former—one in which certain materials are used to give direction or velocity to reactions of a thermal nature. Catalytic cracking plants, it is true, will probably exceed thermal plants in future new construction, but there is no reason to believe that a number of thermal units will not continue to be needed to round out the refinery balance picture.

(5) U. S. 2,370,849, March 6, 1945, Harris A. Dutcher (to Phillips Petroleum Company), "Production of Acrylonitrile."

(6) Anon., NATIONAL PETROLEUM NEWS, *Technical Section*, 36, No. 31, R-566 (1944), "Keeping Up With the News—The Wulff Process."

(7) Smoley, E. R. and Bowles, V. O., *Petroleum Engineer* 16, No. 8, 113, (1945), "Some Considerations of Postwar Petroleum Refinery Operations."

# Maintenance of Products Pipelines

*By F. B. Neptune*

**Methods for the initial exterior protection of pipelines for refined products are described, which have resulted from 14 years' experience of a large oil company. A formal program is also followed for external preventive maintenance which has proved successful in reducing leaking and down time for extensive repairs.**

**Methods for protection from internal corrosion include elimination as far as possible of the principal corrosive agents, air and water, and also the injection into the pumped stream of corrosion inhibitors having no deleterious effect on the product in the line. Where it is necessary to cut the line for repairs, a tapping machine with pressure control fittings is available, the use of which eliminates the necessity of water displacement or extensive draining of the product.**

**For pipelines of the future it is considered probable that within a few years pipe of corrosion proof plastic, or of conventional steel so effectively coated that maintenance will become a minor problem, will be available.**

PUMPING highly volatile products through pipelines, where the pipe is in good condition and the pumping equipment including auxiliaries is designed or adapted to such usage, offers no particular problem. The product, being very light, "pumps easy"—that is, less pump pressure is required to push through a unit volume than would be required to push through an equivalent volume of crude oil, distillate or even ordinary refinery gasoline or motor fuel.

However, a failure in the system handling high volatile products such as high vapor pressure natural gasoline, butane, butylene, butadiene or propane is a serious matter if the failure results in escape of the product. This is true whether the failure occurs in or around a pumping station or out on the line. The volume loss may be serious but is always secondary to the actual or potential loss of life and property by fire and explosion.

The Phillips Product Pipeline System began operating early in 1931. The first product pumped after the water test was butane. Originally the line was not equipped with scraper traps because it was believed in those pioneering days that a line handling only clean products would not require scraping.

Because it was impossible to run scrapers, the butane was pumped right behind the test water. Butane in combination with residual water is a bad mixture and for a while we operated a sort of ice cream line, pumping inflammable slush.

The operating difficulties we encountered in those first few months were anticipated to some degree, but since butane was required for pumping station fuel there was no alternative but to get the fuel to the stations via the pipeline itself. Most stations were remote from railheads and passable roads so that it would have been almost impossible to get butane to the stations by rail and road even if suitable tank trucks had been available.

In 1939, when we built an extension of the line from St. Louis to Chicago, we got butane fuel to the stations by rail and tank truck and did not put a slug of butane into that section of the line until a number of scrapers had been run behind the water and several slugs of heavier product had been pumped through to the Chicago Terminal. Since 1931 we have pumped in excess of 9,000,000 barrels of butane (1,500,000 barrels in 1944 alone) at pressures as high as 1100 psi and the operation has become routine but not unimportant insofar as alert and careful handling are concerned.

This background of 14 years of experience may, by this presentation, be helpful to you who have the responsibility of operating and maintaining pipelines handling butadiene and related products. We have ourselves been helped and are being helped immeasurably by the experience and exchange of ideas with other pipeline operators.

### Initial Exterior Protection

No attempt will be made here to cover this subject fully. There is no general agreement among operators as to the best method of protecting pipelines but the literature on the subject is quite extensive[1]. Phillips' practice is as follows:

Solid coat all cross-country trunk products pipelines, using either asphalt mastic or coal tar enamel with bonded wrap.

On gathering lines or lines of comparatively short use-period, a visual survey is first made of the proposed route and an estimate made of coating requirements based on visual hot spots such as rivers, creeks, road crossings, poorly drained regions, industrial areas, etc. This permits material to be ordered and properly distributed.

After ditching and before the pipe is lowered a soil-resistivity survey is made. The pipe is laid bare if soil resistivity is high and no visual corrosive condition exists. The pipe is given a field-applied coating, either by machine or by hand, of coal tar enamel and a spiral wrap of asbestos felt if soil resistivity is low or visual hot spots are encountered.

Before the coated pipe is lowered into the ditch a conventional type high voltage holiday detector is used to locate any small and otherwise undetected breaks in the coating.

On completion of the line, if there is still some question of the adequacy of the coatings to protect the pipe in certain locations, a survey is made with an electronic coating inspector[2] to locate the faulty coating and make repairs or install cathodic protection.

As regards cathodic protection, it has been our experience that a single energy input point will protect only 800 to 1000 feet of bare 8 in. pipeline through low resistivity soil. On a thin asphalt emulsion coated line it is possible to protect from one half to two miles with one cathodic unit. We have not used cathodic protection on asphalt mastic-coated lines, but we are advised that one mastic-coated pipeline appears adequately protected from corrosion based on soil to pipe potential for a distance of 250 miles with only four cathodic units—over 60 miles per unit.

The amount of initial exterior protection to give a line is governed not only by soil conditions but by consideration of economics, such as expected use-period, tax structure, possible earnings as related to investment, etc., and by consideration of safety, such as nature of products handled, volume and pressures and nature of the area through which the line passes.

### Preventive Maintenance—External

Preventive maintenance should begin when the line is laid, with the utilization of initial protection to the degree dictated by circumstances and conditions previously mentioned. Obviously a line well protected initially or a line with little or no protection traversing noncorrosive terrain will require little attention.

However, it is not always economically feasible to coat a line fully and a compromise in initial investment must be made. This is particularly the case where the utility life of a line is indeterminate or estimated to be short. It can be assumed that most operators will be confronted with maintenance problems sooner or later.

Corrosion is generally accepted as being electro-chemical in nature. As one step in protecting the line after installation, a program of regularly checking

*This paper was presented before the Spring Fire and Safety Meeting, Rubber Reserve Co., St. Louis, May 17, 1945, under the title "Ruptured Pipelines, Preventive Maintenance and Corrective Procedure."* *F. B. Neptune is with Phillips Petroleum Co., Bartlesville, Okla.*

pipe-to-soil potential and line currents should be set up. This will result in locations recommended for inspection. The next step is to uncover the pipe, clean it and make indicated repairs. Phillips practice is as follows:

After the pipe is uncovered it is cleaned, using a power-driven cleaner which employs a cutter head followed by a wire brush head. The mechanical cleaner does the bulk of the cleaning so that only little additional hand work is necessary. Pitting hammers are used to remove scale from any pits found. The depths of the deepest pits in each five-foot section of pipe inspected are measured in order to determine the severity of the corrosion, to correlate findings in the field with those indicated by the corrosion survey, and to furnish necessary information to the maintenance superintendent for deciding how to recondition the pipe.

If the pits are casual and not too deep, they are spotwelded, using ⅛ in. or 5/32 in. electric welding rods. If the pits are too deep to permit safe spot-welding or too numerous to be spot welded economically, they are covered with preformed unbeveled half-soles.

If the condition of the pipe is too bad to permit welding of the half-soles safely, the pipe is cased with preformed split casing beveled on all four sides. The casing is extended beyond the corroded area. After all metal work is completed, pipe half-soles and casing are given a final cleaning.

Coal tar primer is then applied, followed by two ⅛ in. coats of coal tar or waterworks enamel and a spiral asbestos wrap. In locations where the line is continually under water, a flood coat of coal tar enamel is applied over the spiral asbestos wrap for additional protection. After coating, a holiday detector is used to check the coating job. It should be mentioned that all of this reconditioning work is done with the line operating at usual pressure. Only rarely, when the pipe is particularly bad, is the normal operating pressure reduced while welding is in progress. The product flow is continued.

One of the most important segments of the external maintenance program is record keeping. To maintain a pipeline intelligently it is necessary to have correlation between the office and field and between the engineering, maintenance and operating departments.

To accomplish this we employ what is more or less a standard corrosion map, or rather a series of corrosion and maintenance log sheets. Each sheet is 24 in. x 36 in. and represents approximately six miles of pipeline. On it are recorded such data as topography and drainage, surface soil, subsoil, right-of-way notes, soil resistivity and line currents, engineering recommendations and record of maintenance.

Each sheet is suitable for 20 years of record. The maps are kept up to date by regular posting of corrosion engineers' recommendations and plotting of actual reconditioning.

As reconditioning progresses in the field it is reported by the maintenance foremen on a form provided for the purpose. This form when properly filled out shows every detail of the maintenance performed, including location, method of uncovering and cleaning, condition of coating, nature of soil, type of cultivation at the location, pit depth and detail of all reconditioning work done. At least once each year a recap is made from the corrosion maps showing:

TOTAL POINTS recommended for inspection;

TOTAL POINTS inspected;

TOTAL FOOTAGE reconditioning recommended;

TOTAL FOOTAGE reconditioned.

Obviously the reconditioning methods discussed above are expensive but we have found them effective in reducing leaks—and reconditioning can be accomplished without down time.

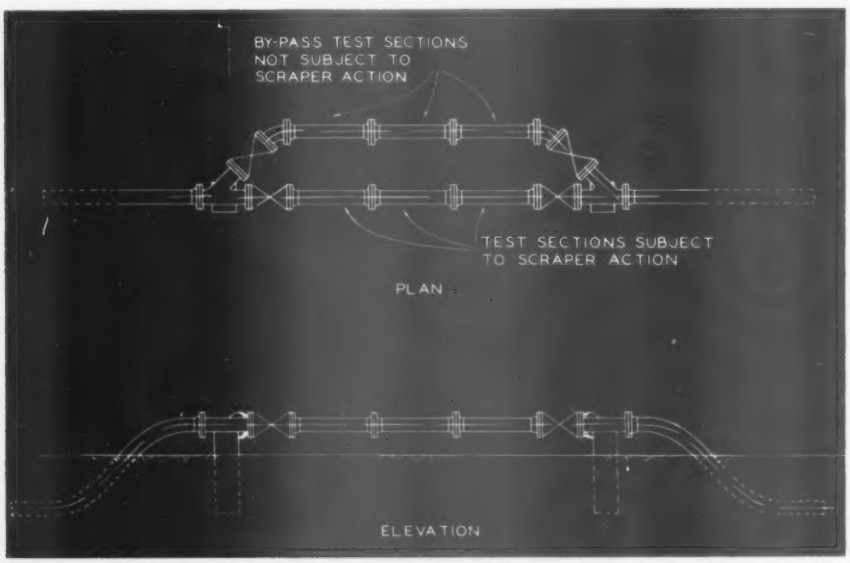


**Fig. 1—Method of installing a removable test section in a products pipeline**

### Preventive Maintenance—Internal

As mentioned previously, when product lines first came into use it was thought there would be no problems involving the internal condition of the pipe[3]. The products pumped would be clean, sweet and non-corrosive—as in fact they generally were and are. Another combination, however, oxygen and moisture, also was present and after various periods of operation (depending upon conditions) it became apparent that internal corrosion was present as evidenced by an increasing quantity of line scale and lowering of the "C" factor[4].

From the experience of gas lines with internal corrosion, all of this might have been anticipated, but apparently most products line operators learned the hard way, and while such internal corrosion in most cases did not even approach calamity as far as loss of metal was concerned, the roughening of the interior seriously affected throughput. Also the scale was a source of pumping trouble and detrimental to the stability of the product.

Since the problem of internal corrosion was first recognized, a number of methods of combating it have been developed. One of the first steps was to eliminate as far as possible the principal agents of corrosion, air and water, from the line. Actually it is almost impossible to keep out small quantities of water, and oxygen in some degree is always present. It has proved more practical to work toward eliminating the oxygen by injecting into the pumped stream such oxygen-absorbing chemicals as sodium sulfite, sodium chromate, sodium nitrite and mercapto benzo thiozole.

As Phillips was one of the first major products pipeline systems our experience with internal corrosion began early and between 1934 and 1939 our research and operating departments devoted considerable attention to the use and effect of corrosion inhibitors[5].

It was necessary to have an inhibitor which would not only do the primary job of preventing corrosion but had no deleterious effect on the gasoline and was simple to handle and inject. After much laboratory and pilot plant testing, mercapto benzo thiozole (Rokon) was decided upon and we began injecting it at the Borger, Tex., origin of our line in 1936. A second injection point was added at the Laverne, Okla., station in 1938 and in the past two years the protection has been extended as far as St. Louis.

Examination of test spools recently on our line between St. Louis and Chicago showed slight internal corrosion and some time this year we expect to install injection equipment and begin adding Rokon in this section.

Engineers are not agreed on the effect

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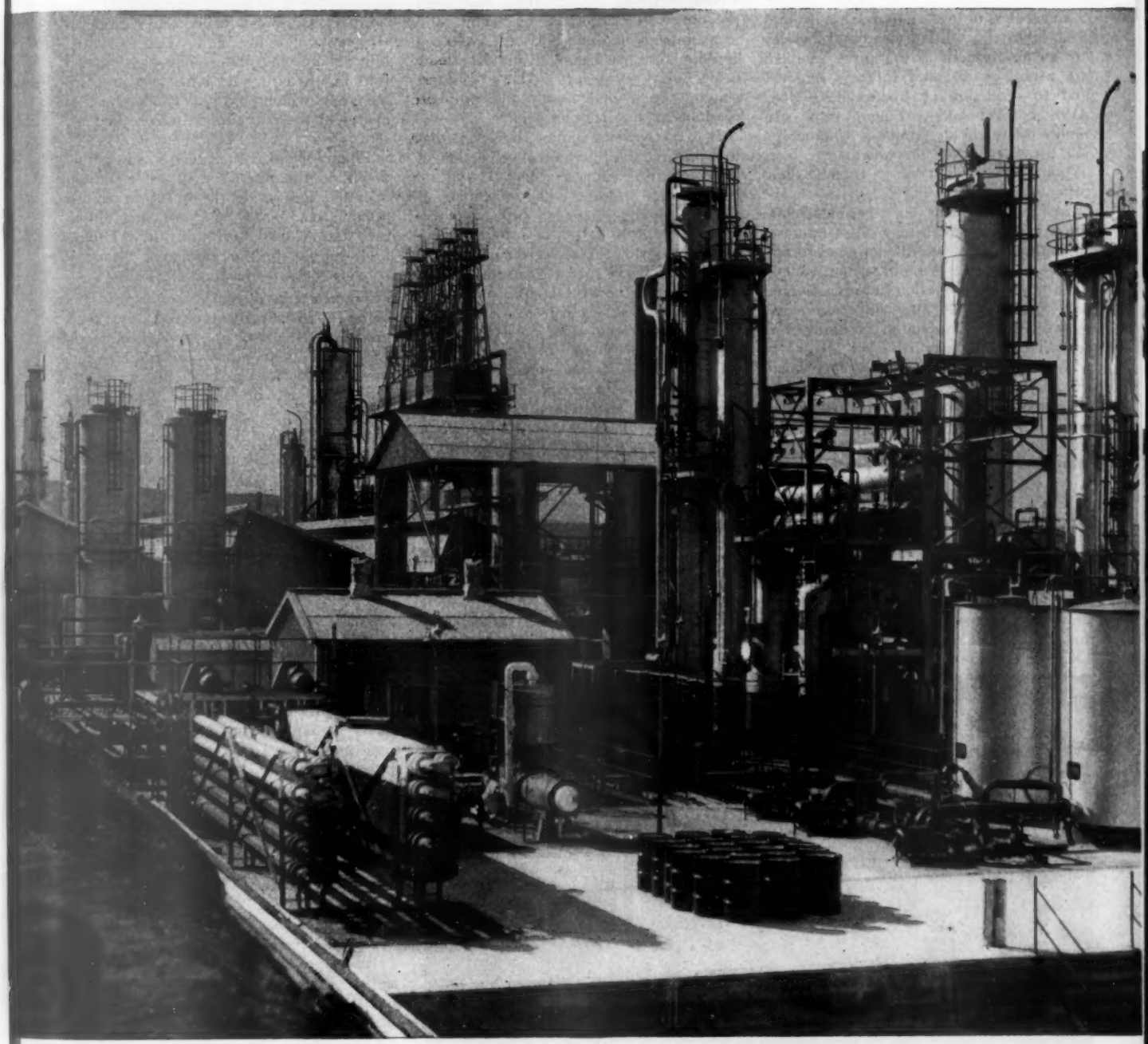

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of scrapers on internal corrosion. Some contend that scraping is beneficial by "squegeeing" out casual water. Others contend that scraping accelerates corrosion by constantly exposing fresh metal surface to attack.

Regardless of this, all agree that if there is an internal condition whereby tubercles are being formed on the pipe, scrapers are useful or essential to their removal and to reduction of hydraulic friction. Also scrapers and sediment traps are highly useful in determining whetner or not there is active corrosion in the line, although this, of course, is not their primary purpose.

In this connection, an experiment conducted on our system may be of interest. In January, 1944, we discontinued scraping in the Borger-Wichita section except for a 42-mile sub-section between Borger and Spearman. In this sub-section we intensified the scraping, running 70 scrapers in 60 days.

With all of this scraping a very small quantity of scale was collected in the trap at Spearman and the "C" factor did not improve. We concluded from this that the line was clean, that scraping was unnecessary and that the inhibitor we had been adding was fully effective.

With the exception of an occasional scraper to remove water, scraping has been discontinued in this section now for more than a year. The "C" factor has remained constant. In December of last year scraping was similarly discontinued in the section between Wichita and Paola—also with no loss in value of "C". We anticipate that after the inhibitor has had time to clean the Missouri and Illinois sections, we also can eliminate our scraping program there.

One method of determining when internal corrosion is occurring has been mentioned i.e., regular scraping and measurement of scale and rust collected in sediment traps. Installation and periodic inspection of corrosion bars or test coupons in contact with the pumped products is another method.

It is the writer's opinion, however, that the only reliable method is inspection of the pipe itself. Rather than relying on adventitious samples taken in course of repair, piping changes, pipe replacement, etc., it is better to install removable test spools at selected points.

It seems likely that a corrosion bar inserted in the top of the pipe might fail completely to reflect corrosion limited to the bottom of the pipe, and vice versa. Also, corrosion bars are not otherwise subjected to the same conditions as the pipe since they must be installed in a bypass where they are not brushed by scrapers as is the pipe itself. One method of installing a removable test section is illustrated in Fig. 1. Such an installation could be used to test simultaneously a number of steels, alloys, interior coatings and inhibitors.

### Ruptured Pipelines

It has been our experience (and our contacts with other pipeline operators indicate our experience is typical) that ruptured lines are very infrequent, at least in the sense of a sudden break. We have installed a number of automatic controls to prevent excess line pressure and otherwise to insure even flow at desired rate.

Each input or product-originating station has a rate-of-flow controller. This instrument will deliver at any rate for which it is set by controlling engine speed. All stations are equipped with line pressure governors which hold either intake or discharge at the pressure for which they are set.

Finally there is an over-pressure shutdown on the discharge of each station, operated independently of the other automatic controls which will shut down the station by interrupting the engine fuel supply if the discharge pressure reaches the safe maximum.

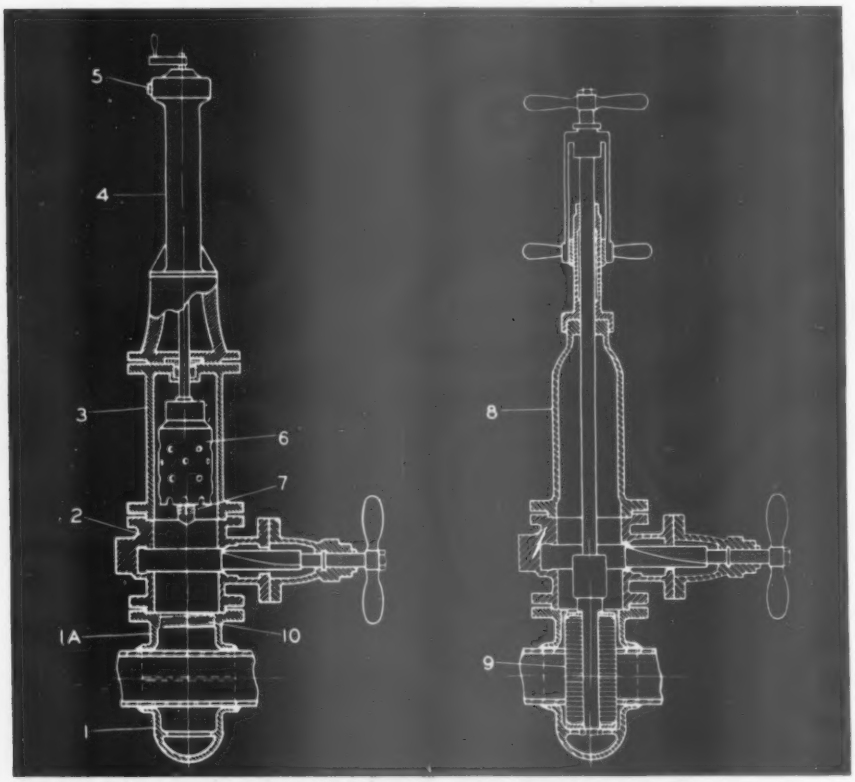
There are the unusual cases of pipelines being inadvertently severed by road graders, washed out and broken by floods and even deliberately dynamited—but these must be classified as accidents, calamities or mischief. The common cause of loss of product from a pipeline is leakage caused by external corrosion.

Sometimes it is necessary to cut the line to remove a stuck scraper, replace an unrepairable section, install valves or insulate flanges, or for other reasons. The location where the pipe has to be cut may be in low profile, remote from block gates so the section cannot be pumped dry. The drainage may extend several miles and involve removing or displacing a large volume of product.

It sometimes is undesirable or impossible to displace the product in the line with water. Tapping the line and hauling the line product to the nearest refinery or bulk station is time-consuming and expensive. There is available a tapping machine with pressure control fittings the use of which eliminates the necessity of water displacement or extensive draining of the product. Developed originally for use on domestic gas service lines, it is now finding wide use on trunk pipelines. This equipment is sketched in Figs. 2 and 3. Briefly, the procedure in using it is as follows:

Forged steel saddle type fittings (1) (1A) are electric welded onto the line in two halves, while the line is still operating if desired. The gate valve (2) is installed with the cutter adapter (3) above. The feed mechanism (4) is mounted on top. The feed mechanism can be operated by hand or by an air motor attached to the feed mechanism at connection (5). The cutter (6) is the same diameter as the pipeline and cuts down through the upper and lower half of the pipe, actually cutting the pipe away. The pilot drill (7) has threads above the point which permit the removal of the blanks after cutting.

After the cutter and blanks are raised above the gate valve, it is closed and everything above the gate is removed. The plug adapter (8) with cylindrical synthetic plug (9) is placed over the




**Figs. 2 (left) and 3—Tapping machine with pressure control fittings for cutting pipelines, eliminating necessity for extensive draining**

gate valve, the gate valve opened and plug forced down to seal off the flow. The plug will seal off against 100 pounds or more of static pressure. If the location is in a valley it may be necessary to plug off at two points to permit working between.

After the repair work is complete the synthetic plug is raised above the gate, the gate closed, and a bronze flat plug inserted in its place. The gate is then opened and the bronze flat plug (not shown) is screwed into threads (10) in the neck of upper saddle fitting (1A). The gate valve and all parts above are then removed. The bronze flat plug is then made up tight by a special wrench, after which a blind flange is bolted onto the upper saddle fitting and the job is complete.

### Future Pipelines

It seems probable that within a few years pipelines can be built with tubes o corrosion-proof plastic or of conventional steel so effectively coated inside and out that maintenance of the line itself will become a minor problem. In fact it is the writer's guess that plastic or plastic coated pipe will be available some time before the pipeline companies are ready to accept it.

This is understandable. Conditions existing on a long trunk pipeline cannot very well be duplicated in the laboratory and the only sure test lies in the field and in time. Regardless of laboratory or pilot installation indications, pipeline operators will be slow to buy and bury miles of any new-type line until they are sure they will not have to dig it up in a few years and start over.

The very fact that a large part of the cost of building a pipeline is for ditching and back-filling makes experimentation on a large scale impracticable. Past experience with protective coatings fully justifies the tendency of the pipeline operators to be a bit "cagey." When the new materials are offered it doubtless will require joint testing by all concerned and substantial proof of performance before there will be general acceptance by the pipelines. And the length of time required before acceptance will depend on how far the new offerings depart from the conventional.

Regardless of what develops for new pipelines, we still have and will have for many years the job of maintaining the old ones.

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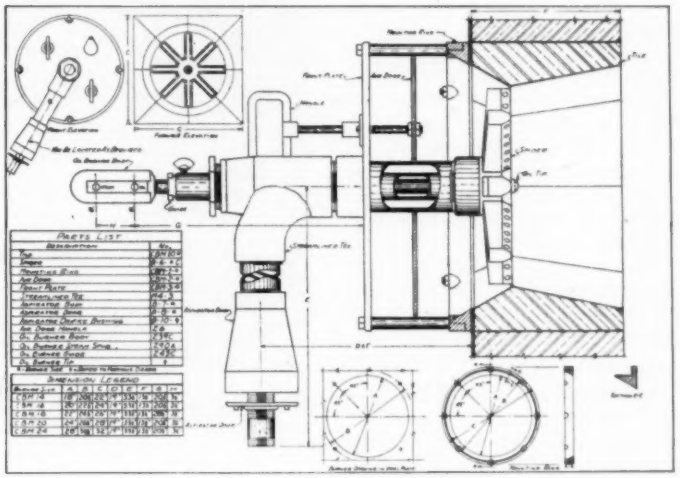

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(*Continued from pg. R-506*)

given in Table 1 were run into the tank before each additional test and mixed with the residue from the preceding test. Samples of the oil in the tank before and after each test were analysed to determine the effect of the fire upon the composition of the oil. The analyses are given with the discussions of the individual tests.

These analyses were run by the Sohio laboratories in Cleveland, as follows: All distillation tests were carried out with 200 cc. samples and in accordance with A. S. T. M. procedure D-158-41, with the exception that cracked ice was used in the condensor bath. All B. S. and water determinations were run in centrifuge equipment in accordance with A. S. T. M. D-96-40, and all water determinations in Dean Stark equipment in accordance with A. S. T. M. D-95-40. Flash tests were run in a Cleveland open cup.

Extensive arrangements were made to secure as much engineering data and information from each test as possible. Wind velocities and directions were recorded during each test, as were temperatures at various points on the tank shell and in the center of the tank.

Tank temperatures were measured by means of 20 thermocouples, 16 located in the tank shell and four in the center of the tank. The 16 in the shell were in four groups of four each, spaced as shown in Fig. 3, and were protected with 18-8 stainless steel thermowells. The four in the middle of the tank were located on the center roof support, which had not been removed, and were protected with 1-in. chrome steel tubing.

The thermocouples were made of No. 20 gauge iron-constantan wire, and were connected to a Leeds and Northrup portable potentiometer calibrated in millivolts, with a manual-compensated cold junction compensator. The lead wires from the thermocouples to the potentiometer were #14 gauge iron-constantan, weather-proofed, and averaged 225 ft. in length.

Maximum range of the potentiometer was 2000°F., so that any temperatures above that point are only approximate. Sohio engineers also pointed out that the temperatures below 50°F. are not to be considered as accurate.

The top row of thermocouples on the shell ( nos. 1, 2, 3, and 4) extended into the tank 5 in.; the next row (nos. 5, 6, 7, and 8) 4 in.; the bottom two rows (nos. 9 through 16), 3 in.

Four movie cameras from the U. S. Navy Photo Science Laboratory recorded all the tests in detail.

## Water Spray Tests

All the tests with plain water as the extinguishing agent were carried out by Automatic Sprinkler Corp. under the direction of E. B. Rumble, assistant manager of that company's Fire-Fog department.

Automatic conducted its tests to find out how effective its automatic "Fire-Fog" system would be in controlling a fire over a large area, such as was encountered in the 93-ft. diameter test tank. According to Mr. Rumble, the principle of water spray when used on fires of flammable liquids is threefold:

(1) Control the fire and prevent its spread, thus (2) protecting any equipment endangered by the fire until (3) the fire is extinguished.

The Findlay tests were carried out along these lines, after a small scale preliminary test at Automatic's test yard in Youngstown had demonstrated that the most effective method of protecting the tank would be to hold the fire under control while the light ends in the oil were volatilized and burned off. As soon as these light ends were no longer being distilled out, the fire in the remaining heavy oil could be extinguished.

Equipment used by Automatic included 84 nozzles, two 6-in. deluge valves and eight heat-actuated devices to set the system in operation automatically, the whole system being tied into the water supply by two 5-in. lines.

Layout of the nozzles, as shown in Fig. 4, was based on a spacing of 10 ft. between nozzles and 10 ft. between lines of nozzles. This layout provided one nozzle for each 100 sq. ft. of surface to be covered. Additional nozzles were installed around the circumference of the tank to protect the voids caused by the arc of a circular tank.

The coverage per 100 sq. ft. with one of these nozzles at various water pressures is given as follows:

| Pressure psi | Coverage gpm |
|---|---|
| 50 | 17.8 |
| 60 | 19.2 |
| 70 | 20.4 |
| 80 | 21.5 |
| 90 | 22.5 |

**Automatic Sprinkler's nozzle installation in the test tank was arranged so that each nozzle sprayed approximately 20 gals. of water per minute over every 100 sq. ft. of flaming oil surface**

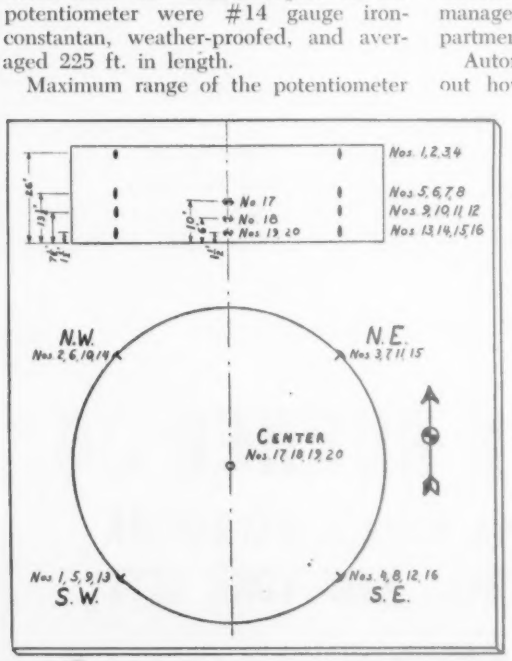


**Fig. 3—Arrangement of the 20 thermocouples in the test tank, used to measure temperatures at key points during the various tests. They were located in five groups of four each, one group on the center pole of the tank and the other four on each quadrant of the tank shell**

*(Correction note: The top row of thermocouples should be shown as being 24 ft. from the tank bottom, not 26 ft.)*

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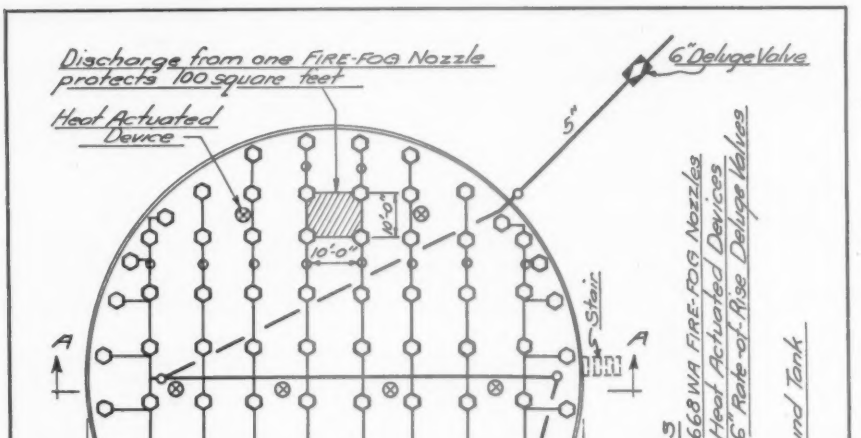


**Fig. 4—Layout of the water lines and nozzles used in the first series of tests, conducted by Automatic Sprinkler Corp. using water spray as the extinguishing agent**

As previously pointed out, operation of the system was entirely automatic, being controlled by the eight heat-actuated devices. These are hollow brass chambers, about 3 in. in diameter and ovoid in shape, connected by ⅛-in. copper air tubing to a diaphragm at the deluge valve.

As heat from a fire develops an air pressure in the chamber, the pressure is conveyed by the tubing to act against the diaphragm, which in turn sets up a mechanical motion that drops a weight or operates an electrical switch to open the deluge valve.

A calibrated vent in the air tubing line permits small pressure variations developed by normal conditions and weather changes to pass out without operating the valve.

Two tests were conducted by Automatic, although the first was run in two distinct stages and is referred to as Test 1-A and Test 1-B.

**Automatic, Test 1-A:** The fire was ignited by throwing an oil-soaked torch into the tank from the stairs. The deluge valves operated in 22 seconds, and water was at full discharge from the nozzles a few seconds later.

The nozzle discharge pressures varied between 75 and 80 psi, which resulted in a coverage of from .210 to .215 gpm of water per sq. ft. The fire seemed to be confined in a circle approximately 20 ft. in diameter about five to 10 minutes after the system had gone into operation. The wind velocity increased 10 minutes afterward, however, and the fire started to spread generally across the tank. Wind velocities during the test were from 6.2 to 8.52 miles per hour, the wind being from the northwest.

Flames were under control at all times and temperatures read at thermocouples (see Table 2) were uniformly low, with a maximum temperature of 110°F. being recorded at the shell.

The fire was extinguished in 20 min., 10 sec., and no damage was observed to the piping, tank or fresh yellow paint that had just been applied to the outside of the tank. Throughout the test, pictures were taken directly into the fire area and the tank could be touched with bare hands at any point without discomfort.

A total of 35,800 gals. of water was discharged into the tank during this test. The oil analysis before the test is given in Table 3; no analysis is available of the residue, however, since the oil layer on the water bottom was too thin to permit sampling.

**Automatic, Test 1-B:** To determine the character of the oil remaining from Test 1-A, the residue oil was ignited by dropping a torch into the tank. The oil ignited immediately and started burning across the surface. The deluge valves were opened in 41 sec., and the fire was extinguished in 3 min., 30 sec. This would indicate that the light ends had burned off, leaving a residue with a flash point between 150 and 250°F. No temperature readings were taken during this test.

The nozzle discharge pressure during the test was 80 psi, resulting in a

TABLE 2—Temperature Data (°F.) From Automatic Sprinkler Tests

| | S.W. tank quadrant | | | | N.W. tank quadrant | | | | S.E. tank quadrant | | | | N.E. tank quadrant | | | | Center of tank | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TEST No. 1** | | | | | | | | | | | | | | | | | | | | |
| **T.C. Nos.** | **1** | **5** | **9** | **13** | **2** | **6** | **10** | **14** | **4** | **8** | **12** | **13** | **3** | **7** | **11** | **15** | **17** | **18** | **19** | **20** |
| 2:56 p.m. | 60 | 80 | 80 | 30 | 40 | 35 | 35 | 30 | 45 | 35 | 35 | 30 | 40 | 35 | 35 | 30 | 35 | 40 | 40 | 40 |
| 2:59 p.m. | 95 | 110 | 100 | 30 | 40 | 35 | 35 | 30 | 65 | 85 | 35 | 30 | 40 | 35 | 35 | 30 | 35 | 40 | 40 | 40 |
| 3:02 p.m. | 100 | 110 | 100 | 30 | 45 | 35 | 35 | 30 | 70 | 105 | 35 | 30 | 40 | 35 | 35 | 30 | 35 | 40 | 40 | 40 |
| **TEST No. 2** | | | | | | | | | | | | | | | | | | | | |
| **T.C. Nos.** | **1** | **5** | **9** | **13** | **2** | **6** | **10** | **14** | **4** | **8** | **12** | **16** | **3** | **7** | **11** | **15** | **17** | **18** | **19** | **20** |
| 5:58 p.m. | 50 | 50 | 50 | 40 | 50 | 50 | 50 | 40 | 50 | 50 | 40 | 40 | 50 | 50 | 50 | 40 | 40 | 40 | 40 | 40 |
| 6:01 p.m. | 55 | 55 | 65 | 40 | 40 | 35 | 40 | 40 | 30 | 35 | 40 | 40 | 30 | 35 | 40 | 40 | 35 | 35 | 35 | 35 |
| 6:04 p.m. | 90 | 85 | 85 | 40 | 45 | 40 | 50 | 35 | 30 | 40 | 45 | 35 | 40 | 40 | 40 | 40 | 35 | 35 | 40 | 40 |
| 6:07 p.m. | 145 | 115 | 90 | 35 | 60 | 65 | 65 | 40 | 50 | 55 | 50 | 40 | 50 | 40 | 40 | 35 | 35 | 70 | 70 | 70 |
| 6:10 p.m. | 140 | 120 | 85 | 35 | 85 | 90 | 85 | 35 | 75 | 115 | 110 | 40 | 65 | 60 | 50 | 40 | 35 | 130 | 155 | 155 |
| 6:13 p.m. | 220 | 155 | 115 | 35 | 120 | 115 | 115 | 40 | 90 | 120 | 115 | 40 | 125 | 90 | 65 | 40 | 35 | 125 | 155 | 155 |
| 6:16 p.m. | 245 | 155 | 120 | 35 | 145 | 110 | 120 | 35 | 140 | 110 | 70 | 40 | 120 | 85 | 60 | 35 | 35 | 130 | 150 | 150 |
| 6:19 p.m. | 260 | 110 | 95 | 35 | 130 | 70 | 95 | 35 | 115 | 90 | 100 | 35 | 95 | 100 | 40 | 35 | 35 | 125 | 120 | 120 |
| 6:21 p.m. | 203 | 105 | 85 | 35 | 195 | 80 | 85 | 35 | 85 | 75 | 85 | 35 | 80 | 60 | 35 | 35 | 40 | 65 | 65 | 65 |
| 6:24 p.m. | 125 | 95 | 50 | 35 | 170 | 60 | 50 | 35 | 60 | 50 | 65 | 35 | 60 | 45 | 63 | 35 | 40 | 65 | 65 | 65 |
| 6:27 p.m. | 90 | 90 | 35 | 35 | 50 | 55 | 35 | 35 | 45 | 35 | 40 | 35 | 45 | 35 | 35 | 35 | 40 | 65 | 65 | 65 |

coverage of .215 gpm per sq. ft. A total of 6400 gals. of water were discharged into the tank during the test. Wind velocities were from 10.2 to 13.9 miles per hour, the wind being from the northwest.

**Automatic, Test 2:** Fresh crude oil was added to the residue from the first tests, and the resulting mixture ignited with a torch as before.

The deluge valve operated in 26 sec., and the fire was held under control and extinguished in 38 min., 42 sec.

The fire in Test 2 was very similar in its action to that of Test 1-A, although slightly higher temperatures were recorded, the peak being 260°F. The tank surface was warm to the touch on the windward side, but cool on the lee side. Complete temperature data is given in Table 2.

Wind velocities during the test were from 21.4 to 25.5 miles per hour, the wind continuing from the northwest.

Nozzle discharge pressures varied from a peak of 95 psi when the deluge valves first opened, to a low of 65 psi 2¾ min. later, after which they were gradually brought up to 90 psi. Coverage at these pressures ranged between .198 and .230 gpm per sq. ft.

The amount of oil burned and the oil analyses before and after the tests are given in Table 3.

In summarizing the results of Automatic's tests, Mr. Rumble stated that they "support the soundness of the principle of fire protection by controlled burning of flammable liquids. The use of this method may well reduce the cost of fire protection for such areas as loading racks, process buildings and areas, flammable liquid pump houses, valve pits and the like."

TABLE 3—Quantity and Analyses of Oil Before and After Automatic Sprinkler Tests

| | TEST 1 | TEST 2 | |
|---|---|---|---|
| Residue (preceding test) bbls. | ... | ... | |
| Fresh oil added, bbls. | 203 | 412 | |
| Total oil in tank, bbls. | 203 | 412 | |
| Oil burned, bbls. | .. | 23 | |
| Residue after test, bbls. | ... | 389 | |
| **Analysis** | **Before*** | **Before** | **After** |
| Gravity, °Be. | 32.9 | 30.6 | 27.8 |
| I.B.P., °F. | 162 | 182 | 214 |
| 10%, °F. | 278 | 327 | 408 |
| 20%, °F. | 368 | 340 | 480 |
| 30%, °F. | 440 | 460 | ... |
| 500°F., % | 38 | 34 | 22 |
| B.S. & Water, % | 0.5 | 4.4 | 3.2 |
| Water, % | 0.1 | 3.6 | 2.9 |
| Flash Point, °F. | Room Temp. | 90 | 120 |

* No sample was taken of the residue in the tank after Test 1 as the oil layer was too thin.

## Mechanical Foam Tests

Tests using mechanical foam and applying it to the tank through fixed applicators previously attached to the tank were conducted on the second and third days of the test (May 1 and 2) by Pyrene Development Corp., and on the last day (May 3) by National Foam System, Inc.

Pyrene's tests were run under the direction of C. G. Durfee, president, who explained that his company "wanted to show what would happen if we used an extravagant amount of both high and low expansion foam." A tank 35 ft. in diameter had been the limit of Pyrene's previous test experience.

Two types of foam were used by Pyrene, each applied in varying quantities—the company's regular commercial foam compound and a special protein type currently being supplied to the U. S. Navy.

Also known as "high expansion" foam compound, the company's regular material is mixed with water at the rate of 1 gal. of foam solution for every 20 gals. of water. The resulting foam solution expands approximately 16 times to produce a total of about 320 gals. of foam.

The Navy's type of material is a "low expansion" compound, which expands only about nine times. It is mixed with water in the same ratio as the regular compound, but results in about only 180 gals. of foam for every gallon of foam compound. The low expansion material, however, produces a foam which is stiffer and tougher. It is not quite as fluid as the high expansion material, which makes it better for application to uneven surfaces, to which it adheres more readily than does the high expansion material.

Pyrene's equipment consisted of six identical foam applicators attached to the tank and spaced evenly around it (one every 60°). Each applicator consisted of two lines running from a point just outside the firewall (where the foam solution was picked up) to the tank, where they merged and ran into a foam maker. The foam maker was connected to a 6-in.

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**Three of the six foam lines used by Pyrene Development Corp. in their tests with mechanical foam are shown in this picture, taken at the point just outside the tank dike where the foam compound was picked up by an 1¼-in. suction line (painted white) and carried to the foam maker at the test tank**

riser which ran up the side of the tank and ended in a gooseneck extending over the top of the tank and so placed as to direct the foam against the tank shell.

The foam applicators were designed to be of such size that three units should, the company felt, represent a proper commercial system for an oil tank of the capacity involved.

Each foam maker was designed to pass 160 gpm of water and to pick up 8 gpm of Pyrene foam compound at an operating pressure of 100 psi at the foam maker

The actual operating pressures at the solution pickup point (some 100 ft. distant from the foam maker but equivalent with valves and els to perhaps 150 ft.) varied from 140 to 185 psi. Allowing for the pressure drop in the line to the foam maker, the actual operating pressures at the tank were probably between 125 and 165 psi. In consequence, the actual quantity of water passed per applicator was between 175 and 195 gpm.

In explaining this equipment setup, Mr. Durfee stated that "the present National Board of Fire Underwriters and National Fire Protection Association foam regulations call for a rate of application of foam which in turn defines a water rate (based on chemical foam, of course) of 10 gpm of water per 100 sq. ft. of tank surface. This would mean 680 gpm of water for a chemical foam system for a tank of this size.

"You will observe that in figuring a system using a nominal 480 gpm of water (three applicators, each passing 160 gpm), we were being rather conservative from the standpoint of water use. When we cut down in our fourth test to two foam makers, we were applying a nominal 320 gpm of water, and actually at the elevated pressure we did not exceed 390 gpm."

Another point which Mr. Durfee brought out was that at the higher pressures, a weaker foam solution was being produced. The system was designed for operation at 100 psi pressure, at which the foam compound pickup would run over 4.5% but under 5% of the water passed (slightly less than 8 gals. per 160 gals. of water). As the water pressure is increased, the pickup of the foam compound also increases—but not at quite as rapid a rate as the increase in water flow. At the higher pressures at which the last tests were run the rate of foam compound pickup was probably of the order of 4%, or about 6.5 gals. of compound per 160 gal. of water.

Pyrene's most recent development for adding foam compound to water was used in these tests—its auto-induction system, which is illustrated in Fig. 5, for which a patent has been applied. As shown in this drawing, the main 2½-in. water line leads directly to the foam maker at the tank.

At the left of the drawing (which corresponds to a point just outside the firewall around the tank) a 1¼-in. line bypasses a small portion of the water, which goes through the primary inductor and picks up the required amount of foam compound. The foam compound in these tests was stored in 55-gal. drums alongside the pickup point.

The mixture of water and foam compound passes through the 1¼-in. line to the secondary inductor at the foam maker. This is of the same nature as the primary inductor but is much larger to allow for the greater quantity of liquid flowing through the 2½-in. water line.

As explained by Mr. Durfee, "the whole principle is that of using a jet at

**TABLE 4—Operating Data from Pyrene Tests with Mechanical Foam**

| | TEST 1 | TEST 2 | TEST 3 | TEST 4 |
|---|---|---|---|---|
| Air temp., °F. | 68 | 76 | 50 | 60 |
| Water temp., °F. | 41 | 41 | 41 | 41 |
| Solution temp., °F. | 47 | 49 | 47 | 50 |
| Water pressure at solution pickup point, psi | 140-150 | 155-165 | 165-175 | 180-190 |
| Pre-burn time, sec. | 210 | 240 | 210 | 200 |
| Time to extinguish, min.-sec. | 4:2½ | 5:56 | 20:0 | 27:0 |
| Type of solution | regular | Navy | regular | Navy |
| Amt. of solution used, gal. | 192 | 288 | 510 | 567 |

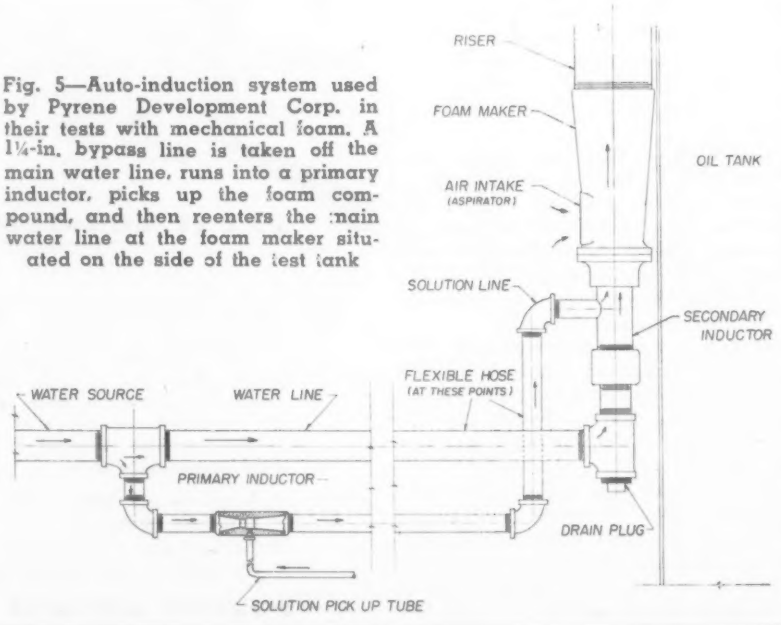


**Fig. 5—Auto-induction system used by Pyrene Development Corp. in their tests with mechanical foam. A 1¼-in. bypass line is taken off the main water line, runs into a primary inductor, picks up the foam compound, and then reenters the main water line at the foam maker situated on the side of the test tank**

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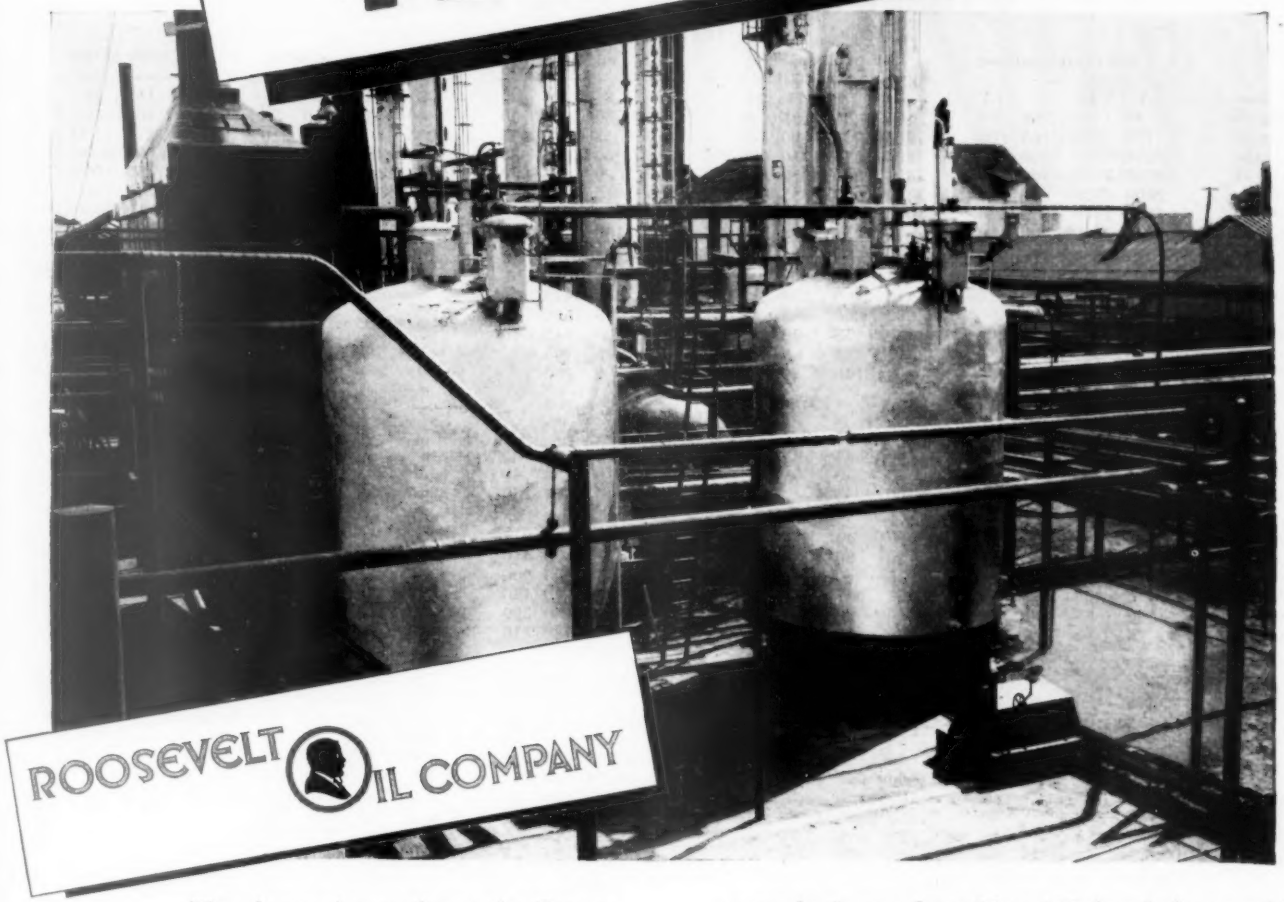


The above picture shows the Petreco Desalting installation of the Roosevelt Oil Company of Mt. Pleasant, Michigan. Referring to the performance of this equipment an officer of the company remarks:

"These two Desalter units handle approximately 5000 bbls. of crude oil per day. The crude charge averages from 60 to 150 lbs. of salt per 1000 bbls. of crude and salt removal averages approximately 93%. Use of these units enables us to run our naphtha unit, which receives our crude charge, from 90 to 100 days before washing and cleaning is necessary. We have also found that the use of the Desalters has made a material saving in operation, due to longer life on exchanger tubes, still tubes and condenser coils."

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R-571

the dike which wouldn't have enough residual energy to push the solution all the way to the foam maker and an inductor at the foam maker which wouldn't have enough energy to suck the solution all the way from the dike; by connecting them in series with one pushing while the other pulls they get the job done."

**Pyrene, Test 1:** Most spectacular of the tests was the first one carried out by Pyrene, in which all six foam applicators and their commercial foam compound were used. In that test the fire was ignited and allowed to burn for 3.5 min., at which time the foam system was turned on. Four min., 2.5 sec. later the fire was extinguished.

Operating data from that and the other Pyrene tests are given in Table 4, temperatures in Table 5, and oil analyses in Table 6. Wind velocities in the four Pyrene tests varied from 3.4 miles per hour in Test 4, when the wind had veered and was from the south, to a maximum of 22.7 miles per hour in Test No. 1, when the wind was from the northwest.

**Pyrene, Test 2:** In the second test, which was carried out about three hours after the first, exactly the same setup was

## TABLE 5—Temperature Data (°F.) From Pyrene Tests

| | S.W. tank quadrant | | | | N.E. tank quadrant | | | | S.E. tank quadrant | | | | N.W. tank quadrant | | | | Center of tank | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TEST No. 1** | | | | | | | | | | | | | | | | | | | | |
| **T.C. Nos.** | **1** | **5** | **9** | **13** | **3** | **7** | **11** | **15** | **4** | **8** | **12** | **16** | **2** | **6** | **10** | **14** | **17** | **18** | **19** | **20** |
| 1:45 p.m. | 40 | 70 | 180 | 30 | 35 | 35 | 85 | 30 | 35 | 50 | 65 | 30 | 40 | 40 | 50 | 30 | 30 | 1405 | 1460 | 1460 |
| 1:48 p.m. | 795 | 920 | 765 | 180 | 205 | 305 | 680 | 140 | 855 | 1015 | 740 | 185 | 335 | 400 | 680 | 210 | 185 | 1270 | 1460 | 1460 |
| 1:51 p.m. | 1290 | 850 | 1260 | 610 | 565 | 1475 | 780 | 620 | 1175 | 900 | 1085 | 585 | 595 | 1485 | 1085 | 630 | 630 | 2000 | 2000 | 2000 |
| 1:54 p.m. | 2200 | 2200 | 860 | 820 | 1855 | 1280 | 870 | 800 | 2200 | 2000 | 865 | 800 | 1675 | 1445 | 840 | 800 | 800 | 1485 | 1745 | 1745 |
| 1:57 p.m. | 2200 | 1720 | 840 | 640 | 1290 | 1090 | 855 | 605 | 1465 | 1610 | 835 | 605 | 1345 | 1240 | 840 | 605 | 605 | 1245 | 1430 | 1430 |
| 2:00 p.m. | 1895 | 1460 | 855 | 620 | 1095 | 985 | 850 | 620 | 1875 | 1325 | 850 | 620 | 1185 | 1385 | 855 | 620 | 620 | 980 | 1020 | 1020 |
| 2:03 p.m. | 1610 | 1240 | 700 | 610 | 890 | 755 | 600 | 480 | 1710 | 1190 | 700 | 580 | 995 | 1200 | 840 | 600 | 460 | 725 | 860 | 905 |
| **TEST No. 2** | | | | | | | | | | | | | | | | | | | | |
| **T.C. Nos.** | **1** | **5** | **9** | **13** | **3** | **7** | **11** | **15** | **4** | **8** | **12** | **16** | **2** | **6** | **10** | **14** | **17** | **18** | **19** | **20** |
| 4:33 p.m. | 70 | 275 | 530 | * | 210 | 60 | 530 | * | 185 | 380 | 425 | * | 40 | 225 | 695 | * | 40 | 500 | 960 | 1010 |
| 4:36 p.m. | 1375 | 1065 | 545 | * | 680 | 600 | 385 | * | 970 | 935 | 530 | * | 920 | 935 | 800 | * | 40 | 330 | 405 | 405 |
| 4:39 p.m. | 985 | 655 | 455 | * | 470 | 1315 | 90 | * | 705 | 530 | 145 | * | 625 | 545 | 460 | * | 40 | 135 | 170 | 170 |
| 4:42 p.m. | 630 | 425 | 110 | * | 315 | 165 | 95 | * | 445 | 205 | 105 | * | 410 | 390 | 35 | * | 40 | 90 | 160 | 160 |
| 4:45 p.m. | 420 | 305 | 95 | * | 280 | 140 | 80 | * | 390 | 190 | 85 | * | 405 | 380 | 40 | * | 40 | 85 | 155 | 140 |
| Note: * denotes thermocouple grounded out. | | | | | | | | | | | | | | | | | | | | |
| **TEST No. 3** | | | | | | | | | | | | | | | | | | | | |
| **T.C. Nos.** | **1** | **5** | **9** | **13** | **3** | **7** | **11** | **15** | **4** | **8** | **12** | **16** | **2** | **6** | **10** | **14** | **17** | **18** | **19** | **20** |
| 11:28 a.m. | 35 | 35 | 40 | 45 | 40 | 45 | 35 | 40 | 40 | 35 | 45 | 35 | 45 | 45 | 95 | 40 | 35 | 40 | 35 | 50 |
| 11:32 a.m. | 35 | 35 | 110 | 40 | 45 | 40 | 35 | 40 | 45 | 40 | 50 | 40 | 140 | 245 | 180 | 45 | 40 | 45 | 45 | 85 |
| 11:36 a.m. | 35 | 35 | 235 | 45 | 50 | 45 | 40 | 40 | 40 | 40 | 50 | 35 | 220 | 120 | 85 | 65 | 35 | 45 | 40 | 70 |
| (See Note #1 below, on Test No. 3) | | | | | | | | | | | | | | | | | | | | |
| 11:45 a.m. | 35 | 50 | 105 | 35 | 35 | 40 | 35 | 35 | 35 | 35 | 40 | 45 | 195 | 80 | 75 | 35 | 35 | 45 | 55 | 35 |
| 11:48 a.m | 85 | 70 | 890 | 645 | 40 | 60 | 1230 | 635 | 40 | 330 | 1800 | 610 | 195 | 395 | 920 | 630 | 630 | 1140 | 1500 | 1505 |
| 11:54 a.m. | 825 | 865 | 840 | 580 | 1255 | 980 | 415 | 40 | 805 | 1095 | 1005 | 600 | 1035 | 890 | 1200 | 140 | 150 | 900 | 1205 | 1210 |
| 11:58 a.m. | 515 | 425 | 385 | 135 | 855 | 605 | 385 | 45 | 655 | 715 | 735 | 420 | 685 | 735 | 755 | 140 | 120 | 490 | 630 | 630 |
| 12:02 a.m. | 100 | 85 | 160 | 165 | 180 | 90 | 60 | 45 | 125 | 150 | 150 | 220 | 120 | 170 | 60 | 115 | 90 | 140 | 160 | 500 |
| 12:06 a.m. | 90 | 80 | 70 | 120 | 125 | 60 | 55 | 40 | 115 | 125 | 130 | 110 | 90 | 95 | 75 | 60 | 70 | 110 | 85 | 240 |
| **TEST No. 4** | | | | | | | | | | | | | | | | | | | | |
| **T.C. Nos.** | **1** | **5** | **9** | **13** | **3** | **7** | **11** | **15** | **4** | **8** | **12** | **16** | **2** | **6** | **10** | **14** | **17** | **18** | **19** | **20** |
| 3:30 p.m. | 40 | 110 | 230 | 35 | 40 | 140 | 370 | 35 | 230 | 170 | 310 | 35 | 40 | 100 | 435 | 35 | 35 | 920 | 760 | 760 |
| 3:33 p.m. | 455 | 845 | 985 | 40 | 1230 | 1200 | 735 | 35 | 985 | 1180 | 730 | 35 | 690 | 880 | 1160 | 35 | 35 | 1120 | 1230 | 1230 |
| 3:36 p.m. | 805 | 775 | 730 | 40 | 1555 | 1450 | 900 | 35 | 730 | 1515 | 1030 | 35 | 980 | 1060 | 1235 | 35 | 35 | 1080 | 915 | 945 |
| 3:40 p.m. | 805 | 780 | 560 | 45 | 1600 | 1555 | 1330 | 35 | 560 | 1570 | 1280 | 35 | 880 | 940 | 1110 | 35 | 35 | 805 | 1235 | 1110 |
| 3:43 p.m. | 870 | 710 | 550 | 40 | 1550 | 1650 | 1370 | 35 | 550 | 1615 | 1270 | 35 | 805 | 935 | 1110 | 35 | 35 | 745 | 1080 | 970 |
| 3:46 p.m. | 670 | 475 | 125 | 40 | 1460 | 1535 | 1405 | 35 | 125 | 1575 | 1450 | 35 | 730 | 945 | 1115 | 35 | 35 | 730 | 940 | 990 |
| 3:51 p.m. | 585 | 280 | 95 | 40 | 1250 | 1465 | 1475 | 35 | 95 | 1235 | 1075 | 35 | 635 | 785 | 915 | 35 | 35 | 310 | 500 | 420 |
| 3:56 p.m. | 240 | 185 | 75 | 40 | 610 | 670 | 720 | 35 | 40 | 465 | 485 | 35 | 295 | 335 | 365 | 35 | 35 | 110 | 215 | 320 |
| 4:01 p.m. | 210 | 85 | 50 | 40 | 400 | 510 | 540 | 35 | 65 | 210 | 320 | 35 | 180 | 320 | 320 | 35 | 35 | 85 | 110 | 125 |
| (See Note #2 below on Test No. 4) | | | | | | | | | | | | | | | | | | | | |

Note 1: Foam from Test No. 2 still remained on top of fresh oil after 18 hours from time to last test. After unsatisfactory attempt to ignite oil, Pyrene commercial type foam was applied at northeast side of tank and fire was extinguished except for small fires at edge of tank. At 11:45 a.m. oil in tank re-ignited from small flames at northeast quarter, and Test No. 3 was completed.

Note 2: Thermocouples 13, 15, 16, 14 and 17 were found to be grounded out after completion of test.

## TABLE 6—Quantity and Analyses of Oil Before and After Pyrene Development Tests

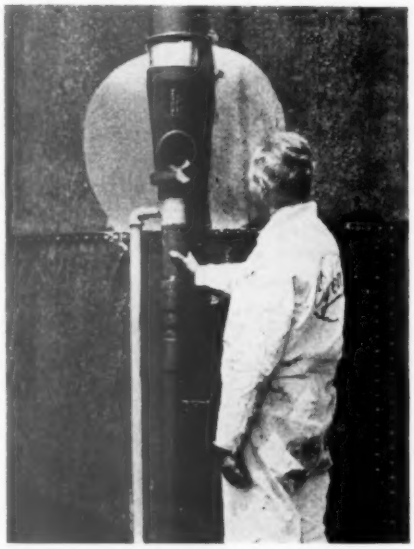
| | TEST 1 | | TEST 2 | | TEST 3 | | TEST 4 | |
|---|---|---|---|---|---|---|---|---|
| Residue (preceding test) bbls. | 389 | | 1644 | | 2169 | | 2699 | |
| Fresh oil added, bbls. | 1282 | | 581 | | 702 | | 600 | |
| TOTAL oil in tank, bbls. | 1671 | | 2225 | | 2871 | | 3299 | |
| Oil burned, bbls. | 27 | | 56 | | 172 | | 233 | |
| Residue after test, bbls. | 1644 | | 2169 | | 2699 | | 3066 | |
| **Analysis** | **Before** | **After** | **Before** | **After** | **Before** | **After** | **Before** | **After** |
| Gravity, °Be. | 32.0 | 31.6 | 31.7 | 31.4 | 31.5 | 31.1 | 31.5 | 30.8 |
| I.B.P., °F. | 158 | 172 | 166 | 185 | 158 | 192 | 158 | 170 |
| 10%, °F. | 280 | 295 | 294 | 302 | 292 | 315 | 292 | 314 |
| 20%, °F. | 360 | 375 | 370 | 380 | 374 | 390 | 374 | 382 |
| 30%, °F. | 442 | 450 | 452 | 455 | 458 | 460 | 458 | 476 |
| 500°F., % | 37 | 34.5 | 36 | 33.5 | 36 | 31.9 | 36 | 33 |
| B.S. & Water, % | 0.7 | 0.8 | 0.8 | 0.9 | 1.9 | 1.7 | 1.9 | 1.7 |
| Water, % | 0.6 | 0.6 | 0.6 | 0.7 | 1.6 | 1.4 | 1.6 | 1.4 |
| Flash Point, °F. | Room temp. | | Room temp. | | Room temp. | | Room temp. | |

used except that the foam compound was the protein type which Pyrene is furnishing to the U. S. Navy Bureau of Ships on a special contract.

This test gave about the same results as were obtained on the first, although the time to extinguish the fire completely was a bit longer—5 min., 56 sec. A 4-min. pre-burn had been allowed, however as compared to a 3.5-min. pre-burn on the first test.

Data on this test are given in Tables 4, 5, and 6.

**Pyrene, Test 3:** The third test was delayed somewhat by a very considerable amount of foam which remained on the oil surface of the test tank from the tests of the afternoon before. This was the Navy' low-expansion foam, which, as previously pointed out, is much tougher than the high expansion material.



**The other end of Pyrene's auto-induction system, where the foam compound (white line) joins the main water stream (black line) and enters the foam maker. The hole in the foam maker is the air intake. The foam compound, water and air all mixed together at this point expand as much as 16 times to produce a fire-smothering foam which is released through a gooseneck extending over the top of the tank**

After the fire was ignited, it burned locally, being held from spreading by the foam on the oil. In an attempt to agitate the oil and move the floating areas of foam, all six foam makers were turned on, discharging water only.

This method at first didn't appear to be having any effect, and it was then decided to extinguish the partial fire, break up the foam blanket with water streams, and start all over. One foam maker was turned on, but at that point the fire began to spread, so that this foam maker was turned off and the fire gradually enveloped the tank.

This entire preliminary period of about 10 min. was not counted in the pre-burn time for this test. The pre-burn was re-

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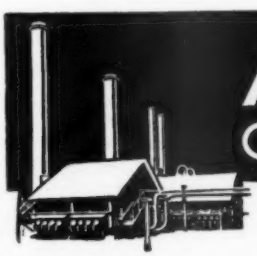

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**Mechanical foam was applied to the fire by Pyrene through six gooseneck applicators extending up the side of the tank and over the top. The applicators are so designed as to cause the foam to flow down the side of the tank shell and spread a thick blanket of foam over the oil surface**

corded as starting when the tank was completely enveloped in flames.

The foam system in this third test consisted of three of the foam makers, every other one being used. The solution used was the same as in the first test—Pyrene's commercial foam compound.

As brought out by the temperature records in Table 5, this fire was brought under control in about 4 min., and the entire time for complete extinguishment was 20 min. Other data are given in Tables 4 and 6.

**Pyrene, Test 4:** In the fourth Pyrene test, an attempt was made to extinguish the fire with the use of only two foam units involving a rate of foam application of about 2400 gpm, or about .36 gals. of foam per sq. ft. of burning surface per min. This test was conducted with the Navy-type foam compound.

The two foam makers did not extinguish this fire. During the first 15 min. the fire seemed repeatedly to be coming under control and then began to get out of control. At the end of about 15 min. a third foam maker was turned on and the fire put out in a total of 27 min. With the three foam makers in operation, foam was being applied at the rate of some 3600 gpm, or about .53 gals. per sq. ft. per min.

A few minutes before total extinguishment was effected, one of the three spraying foam makers broke; it was turned off and another turned on.

National's test was also carried out with mechanical foam, using the company's Aer-o-Foam compound, which is designed for an expansion of eight to 10 volumes.

Arrangements were made to apply foam to the burning surface of the oil through two Moeller tubes attached to foam chambers located diametrically opposite each other in the top ring of the tank. Below each foam chamber and outside the tank was a foam maker, which aspirated air into a stream of water containing 6% of the foam compound. This stream of water and compound was delivered to the aspirating device by a line from an OCD pumper located outside the fire wall.

One pumper was used for each foam maker, although they were operated at only half their rated capacity of 500 gpm. Attached to each pumper was a National Foam pump proportioner, which metered and introduced the foam compound into the water in the desired 6% proportion.

**National Foam Test:** Only one test was conducted by National Foam, on the afternoon of May 3. Some difficulty was again experienced in getting the fire started because of the foam remaining on the oil surface from previous tests. The oil was ignited as before, however, and the fire allowed to burn for 7.5 min. to cover the entire tank area.

Then the proportioner valve on one of the pumps was opened, the micrometer valve was adjusted to 6% liquid pickup, and the foam started into the foam chamber. The same procedure was followed on the second pump, requiring 30 sec. before full operation on both pumps. Each pump was operated at 240 gpm. The pressure was maintained at 135 to

TABLE 7—Temperature Data (°F.) From National Foam Test

| | S.W. tank quadrant | | | | N.E. tank quadrant | | | | S.E. tank quadrant | | | | N.W. tank quadrant | | | | Center of tank | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T.C. Nos. | 1 | 5 | 9 | 13 | 3 | 7 | 11 | 15 | 4 | 6 | 12 | 16 | 2 | 6 | 10 | 14 | 17 | 18 | 19 | 20 |
| 3:12 p.m. | 110 | 45 | 60 | * | 130 | 80 | 80 | * | 120 | 100 | 65 | * | 35 | 70 | 148 | * | * | 90 | 60 | 85 |
| 3:15 p.m. | 130 | 95 | 80 | | 190 | 310 | 115 | | 140 | 265 | 115 | | 70 | 195 | 516 | | | 120 | 95 | 195 |
| 3:18 p.m. | 180 | 185 | 110 | | 270 | 565 | 210 | | 360 | 615 | 185 | | 114 | 290 | 591 | | | 140 | 140 | 440 |
| 3:21 p.m. | 345 | 350 | 245 | * | 390 | 785 | 380 | * | 510 | 950 | 330 | * | 140 | 330 | 937 | * | * | 145 | 250 | 890 |
| 3:24 p.m. | 630 | 590 | 420 | | 590 | 880 | 1200 | | 728 | 1200 | 1080 | | 920 | 1315 | 1340 | | | 160 | 315 | 690 |
| 3:27 p.m. | 1970 | 955 | 435 | | 1230 | 1230 | 1360 | | 825 | 1080 | 1070 | | 1915 | 800 | 1155 | | | 190 | 400 | 410 |
| 3:30 p.m. | 770 | 580 | 1730 | | 1010 | 1400 | 1560 | | 1465 | 1675 | 1530 | | 1170 | 1300 | 1240 | | | 140 | 495 | 400 |
| 3:33 p.m. | 875 | 895 | 770 | * | 1040 | 1285 | 1345 | * | 1715 | 1750 | 1575 | * | 945 | 965 | 875 | * | * | 160 | 365 | 330 |
| 3:36 p.m. | 1460 | 1380 | 1150 | | 785 | 985 | 1140 | | 1320 | 1575 | 1580 | | 880 | 850 | 735 | | | 220 | 294 | 270 |
| 3:39 p.m. | 1675 | 1640 | 1450 | | 1080 | 1200 | 1370 | | 1665 | 1840 | 1600 | | 1020 | 815 | 640 | | | 235 | 225 | 190 |
| 3:42 p.m. | 1630 | 1620 | 1430 | | 830 | 890 | 930 | | 1480 | 1745 | 1630 | | 815 | 760 | 570 | * | * | * | * | * |
| 3:45 p.m. | 1171 | 965 | 985 | * | 1305 | 775 | 900 | * | 1060 | 1635 | 1625 | * | 520 | 330 | 310 | | | * | * | * |
| 3:48 p.m. | 595 | 550 | 580 | | 395 | 490 | 595 | | 1545 | 1715 | 1590 | | 285 | 130 | 215 | | | | | |
| 3:53 p.m. | 400 | 395 | 435 | | 270 | 350 | 410 | | 890 | 935 | 940 | | 190 | 115 | 180 | * | * | * | * | * |
| 3:56 p.m. | 310 | 305 | 373 | | 205 | 275 | 310 | | 565 | 645 | 675 | | 150 | 100 | 110 | | | | | |
| 3:59 p.m. | 180 | 240 | 290 | | 180 | 210 | 240 | | 430 | 410 | 410 | | 110 | 90 | 90 | | | * | * | * |
| 4:04 p.m. | 140 | 130 | 255 | * | 155 | 180 | 185 | * | 265 | 340 | 290 | * | 95 | 75 | 75 | * | * | | | |

Thermocouples 13, 14, 15 and 16 were grounded during test.

Thermocouples 18, 19 and 20 show low temperatures and may have been partially grounded before the 3:42 p.m. reading and were totally grounded after that time.

**National Foam System's Moeller tube, designed to spread the foam gently on the surface of the burning oil rather than letting it shoot down into the oil in a solid stream. These tubes are woven of fine asbestos-covered copper wire and are attached to a foam chamber in the top ring of the tank shell**

140 psi, which gave 100 psi at the foam makers.

In less than a minute after start of the foam application, the tank buckled on one side and broke a coupling below the aspirator. This break allowed a large part of the liquid being delivered to that side of the tank to go out in the air. The exact proportion thrown outside is not known.

A second difficulty also hampered this test. The Moeller tubes had been let down into the tank before the fire was started, for photographing. Normally they are rolled up in the foam chamber until the foam is applied.

During the long pre-burn, during which there was no foam flowing through the tubes to protect them, the tubes were destroyed. As a result the foam shot out and down some 20 ft. where it dived into the oil in a manner to coat it with oil and partly destroy its effectiveness.

The tube on the right hand side may have been partly effective, however, according to Hart Fleming, vice-president of National Foam, because after about three minutes of foam application, the fire on that side of the tank appeared to be under control.

Time to extinguish the fire was 35.5 min. with apparent coverage being achieved in 23 min. and the fire being brought under control in 28 min.

Toward the end of the fire, a small flame remained on one side of the tank directly under the foam chamber, indicated that the diving foam was keeping the fire agitated. Pressure on this chamber was reduced to 75 lbs., and shortly thereafter the fire went out.

It had been planned to apply the foam at the rate of .65 gals. of foam per sq. ft. per min., which, according to National Foam's engineers, is just under existing practice in the oil industry for a good foam properly applied. Due to the broken coupling, the rate of application was probably somewhere between .4 and .55 gpm per sq. ft.

A total of 1020 gals. of foam compound were used in this test, with 17,000 gals. of water. Water temperature was 58°F. and solution temperature 54°F.

Temperature data and oil analyses on this test are given in Tables 7 and 8, respectively.

**TABLE 8—Quantity and Analyses of Oil Before and After National Foam Test**

| | |
|---|---|
| Residue (preceding test) bbls. | 3,066 |
| Fresh oil added, bbls. | 533 |
| Total oil in tank, bbls. | 3,599 |
| Oil burned, bbls. | 140 |
| Residue after test, bbls. | 3,459 |

| Analysis | Before | After |
|---|---|---|
| Gravity, °Be. | 31.3 | 30.7 |
| I.B.P., °F. | 156 | 176 |
| 10%, °F. | 292 | 322 |
| 20%, °F. | 371 | 402 |
| 30%, °F. | 454 | 480 |
| 500°F., % | 37 | 32 |
| B.S. & Water, % | 1.0 | 0.7 |
| Water, % | 0.8 | 0.5 |
| Flash Point, °F. | Room temperature | |

## Summary

Water spray very definitely was effective in keeping the fire under control and in preventing the temperatures from rising to the point where they could damage equipment. The water spray tests were based, however, on a fire involving an unrefined crude, and depended on burning off the light ends before the fire was extinguished. How effective such a method of protection would be on a fire involving refined products wasn't demonstrated in these tests.

The mechanical foam tests were particularly noteworthy because they involved equipment which was still in the experimental stages, and because of the comparative newness of that extinguishing agent.

An interesting continuation of these tests, some observers commented, would be the combination of some automatic actuating device, such as was used in the water spray tests, with a foam system that required no operators to keep it in action.

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# WIDENING HORIZONS

**Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers Is Invited**

## *Project for Technology Seen in the Diesel Fuels Field*

THE great part that airplanes have played in the war and the attention given their engines and fuels have overshadowed the development of another type of power producer which also uses a petroleum fuel, namely; Diesel engines.

Diesel horsepower used in military operations has increased at a startling rate during the war, foreshadowing increasing use in commercial installations when the war ends. There will be a wide range of such applications, authorities agree, in stationary power plants, merchant vessels, railroad locomotives, as well as buses and trucks.

Such a large increase in the consumption of Diesel fuel in coming years is foreseen that at least one group of users, the railroads, is making an intensive study of sources for Diesel fuel as preliminary to long range programs for conversion from steam horsepower to Diesel locomotives. The oil companies, while they see no lack of petroleum or substitute liquid fuels, do express concern as to the availability of Diesel fuels of adequate quality in the years to come, particularly if the quantity should be limited by unduly restrictive specifications of consumers.

The petroleum refiner, while facing an increased demand for Diesel fuels in the future, may find it necessary to make other uses of stocks suitable for Diesel fuel manufacture, as for example the diversion of feed stocks that could be used for Diesel fuels to make high-octane gasoline. F. C. Davern, manager of Railroad Sales Department, Standard Oil Co. of New Jersey, in an article in *Railway Age* predicts progress in refining technology will be along the lines of developing methods for improving the ignition qualities of the low-cetane number Diesel fuel stocks resulting from cracking operations, to overcome the possible deficiency in supply.

One available process, he says, will be the use of solvent extraction to remove the more aromatic low-cetane, high-sulfur compounds and leave the paraffinic compounds possessing better characteristics for Diesel fuels. Sulfur dioxide would be the solvent most likely to be used, he states, as it is already being employed regularly and successfully to refine fractions related to Diesel fuel stocks.

Another method for improving the quality of Diesel fuel stocks is by hydrogenation. The chemical changes that take place by introducing hydrogen into the molecular structure raise the quality of the oil as Diesel fuel. Hydrogenation has the advantage over solvent extraction of giving greater yields of oil and bringing about a more complete elimination of sulfur, it is brought out.

Still another method for improving the cetane number of Diesel fuels will be by the use of additives. A large number of substances are now known and patented which, when added to a Diesel fuel in small amounts, effect a significant increase in cetane number just as tetraethyl lead improves the octane rating of gasoline.

"While Diesel fuels are needed in increasing quantities," concludes Mr. Davern, "the wide and varied uses of Diesel power have radically modified views for fuel requirements. However, progress in petroleum technology will assure the development of superior Diesel fuels in the future."

## *Oklahoma School Solicits Oil Research Projects*

IN VIEW of the scarcity of research manpower continuing into the postwar years, it has been suggested that more industrial research problems be farmed out to colleges. This would make greater use of school research staffs and would enable the company research personnel to apply itself to a greater degree to purely company investigations.

A prospectus from the Engineering Experiment Station of Oklahoma Agricultural and Mechanical College at Stillwater is along this line and solicits research jobs for the Station. Among the many interesting points of the brochure are the statements that (1) A. & M.'s faculty, already possessing many capable men on its staff, will double in size probably within the next two years and that (2) if industry will plan soon enough, so that new faculty members may be chosen not only for their teaching ability but also for their qualifications in specific research fields, then the maximum return for money invested in research will be possible.

The booklet points out that present laboratory equipment at the college undoubtedly will be supplemented by purchase of surplus war equipment, while returning veterans taking advantage of the educational offers in the G. I. Bill of Rights will be available to operate these facilities. Thus, the prospectus candidly states a carefully planned research program by industry, if presented before the end of 1945, will materially affect the equipment and faculty available for research during the next 25 years at this scientific school.

Similar conditions undoubtedly exist at other institutions throughout the nation. In many cases an industry's problems can be more economically investigated in the colleges than in company-owned research laboratories, either because they require equipment not available in the company laboratory or because the problem involves various fields of science not closely related and personnel of the training and experience in the other fields is not in the company employ.

The so-called "small" refiners elsewhere might well find similar research arrangements could be worked out with schools in their territories. If this were done, it would help remove the basis for one of the talking points so often found cropping up in Congressional attempts to regimentize research, namely, that the "li'l feller" cannot afford to establish or support research facilities comparable to those owned by the giants of his industry. It has been suggested that the small refiners particularly use the research facilities at colleges and universities before other industries engage their capacities fully. Where the cost of certain projects is too high for the individual refiner, he might seek partners from other companies interested in the same projects, who would benefit equally through the findings.

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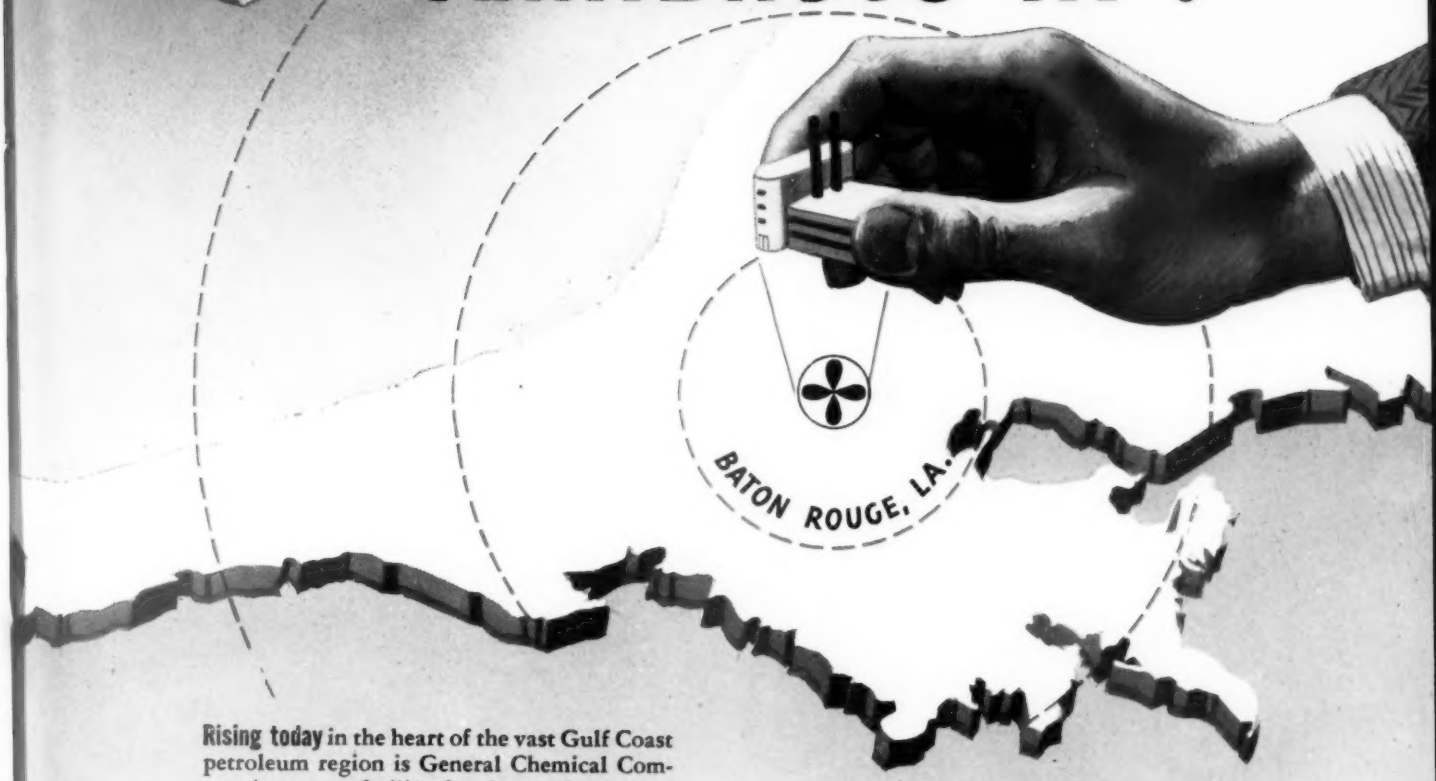


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